PENGUIN HANDBOOKS

Bee keeping

KENNETH K. CLARK

How bees live

How to look after them

Honey and wax production

Bee diseases

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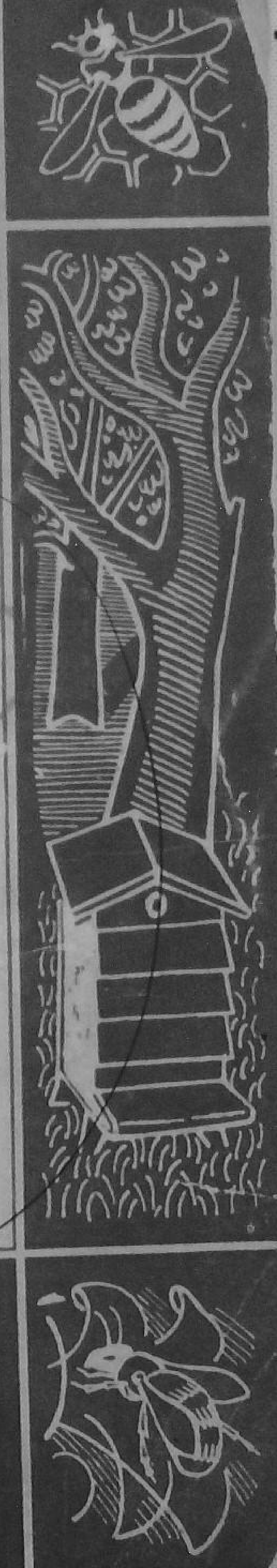

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ABOUT THIS BOOK

Although this is an amateur's guide and is written to be read by those who have no experience of beekeeping, it is hoped that it goes far enough beyond the elementary to be of interest to those with more experience who like to compare notes with another. Several books have been published recently about bees which are meant primarily to inculcate some system of beekeeping, whether revolutionary or primitive, but this is not one of those. It is about common practice in beekeeping, and against fads. Nor is it a sentimental journey among the many marvels of the bees' community. It tries rather to appeal to those who think of beekeeping as a hobby which is potentially profitable – to the hard head behind the inquiring mind.

The book is divided into three parts. There is a short description of the way in which bees manage their own affairs and of the simpler methods of beekeeping which have led up to modern practice; then the main part, which deals with management at different times of the year; and in the third part are grouped together some subjects such as disease, making increase and handling honey and wax, which are best treated outside the seasonal story.

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BEEKEEPING

K. K. CLARK

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NOTE IN PREFACE

In a small book on a subject which is both large and complicated the writer has to choose between mentioning every detail and every line of approach with little elaboration, or discarding much for the sake of clarity. I have discarded, and in doing so I have neglected much equipment and even more techniques, and I apologize to those whose favourite methods are not mentioned. I only hope they will find something in the book to compensate for the omission.

My thanks are due to Alan Thompson and Geoffrey Sykes for their help at the beginning of this venture, to Betty Fanshawe for the drawings, to H. Teal and Robert Bennett for the photographs, and to the A. I. Root Co. for permission to copy two drawings.

KENNETH CLARK

Farley,
Near Salisbury

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INTRODUCTION

Bees are very ancient creatures. They were fully developed in their present form before modern mammals had evolved from their primitive beginnings, long before man had become man.

They have a marvellously intricate organization, but they are not in the least clever. Except that they can live in holes of odd proportions, and shape their nests to fit them, they cannot adapt themselves at all. Their minds (and the mind belongs to the colony, and not to the individual bee) run on rails like a tram. Something may switch the points and send the colony off along a different track, but always it sticks to the track, and there are not many tracks along which it can be turned. Every bee is devoted to its colony and will freely give its life to protect it, but once the mind of the colony is set along the wrong track it will destroy itself with the same frantic enthusiasm as it shows in defending itself. It will destroy itself because it cannot think. I will quote three instances of this, but they are only three out of many you will come across from time to time among your bees.

If you expose honey or syrup in a room with an open crack under the door and a closed window, a few bees will probably find their way in. When they are out looking for food, bees act for a short time as individuals, but the colony is always close behind them, and without the colony to go back to they will not even search for food to keep themselves alive. These bees will fill themselves with honey and fly to the window. After a long struggle to get through the glass, they will form themselves into a helpless little cluster and die. Nothing will persuade them to look for another way out. The way out of a dark place is to fly to the light. There cannot be another way. But their

more intelligent relations, the wasps, will arrive in larger numbers. They, too, are unaware of glass, and will fly to the window. They may stay there a long time before they look for the other way out, but they will find it, and soon establish a regular traffic under the door, spending less and less time on the tantalizing glass as they learn the way they have to go.

A colony of bees which has no queen, nor any eggs or young from which it can rear a queen, is doomed. The queen is the only mother, so such a colony must quickly die out. If you think to revive their hopes and give them a queen (without special precautions) they will promptly kill her, not suddenly, before they have time to think, but slowly. Even second thoughts would save her, but they have no thoughts at all. If they had, they would no doubt say, 'We don't like this queen, but beggars can't be choosers. We must accept her to save ourselves.' Or at least 'We don't like her, but at least we must let her lay one or two eggs so that we can rear ourselves a queen.' But no. Strange queens are killed. The ball of bees closes round her like a vice, and unless the beekeeper interferes again that colony perishes.

Sometimes bees treat their own queen as a stranger and kill her, especially when she comes home newly mated. At this stage she has not laid an egg, and the colony's life hangs on hers. But something persuades them that she is a stranger, and in destroying her the colony commits suicide.

I like to quote this kind of behaviour when somebody says that bees are 'clever little creatures'. They do not reason, and because they do not reason they are impossible to tame. Nothing that beekeepers have done has in any way altered the bee itself. Bees still freely exchange between their natural nests in trees and buildings and the complex hives we make for them; and no one, examining

a swarm newly established in a hive, can tell whether that swarm came from another hive or from a tree. We have altered the *colour* of our bees by importing yellow bees from Italy and other places to mix with our own native black bees, but these yellow bees are just as ready as any others to live again in the wild state.

No colony of bees shows any sign of recognizing its owner or learning any trick of domestication, as all cows, more or less, learn to be milked without protest. The idea that bees recognize people comes, I think, from the fact that they dislike some people more than others. Some they sting without provocation, others only when provoked. On the whole, those who keep bees are those who are by nature less liable to be stung, and they know how to handle bees without provoking them unduly, so that people get the idea that the bees know them. But it will always be found that they handle strange bees with the same freedom as their own.

Bees, then, do not think and cannot be tamed; and they are not in any way human. That seems obvious enough, but a surprising amount of misdirected effort springs from a vague notion that because they live in little houses they must in some way be treated with a human sense of values. Many of these human notions have for a long time been incorporated in our hives, and have only recently been called in question. We put the entrance on the ground floor, although at least for a part of the year it is probably better upstairs; we provide a flat threshold or flight-board, although the bee lands equally well on a vertical surface, as on the trunk of the tree in which it lives; we even put porches over the entrances, quite forgetting that bees do not go out in the rain. These things are trivial, but if you give your bees central heating (as many people have done from time to time) you will destroy them, because they will expect it to be warm outside too.

To manage any creature well you must in some sense get inside its mind and know how it works. A good bee-keeper knows the tracks along which the mind of a colony can be made to run; he knows how to change the track and when to do it, and he is constantly on the watch for the mistakes which the bees themselves make. He fools them often. When they want to swarm, he deludes them that they have swarmed or that they are a swarm; when he wants them to breed fast, he uses sugar syrup to give them a feeling of prosperity; but it is only within narrow limits that he can alter their behaviour. In the main his job is to help them to live their own lives to his best advantage.

PART I

BEES AND HIVES

Chapter 1

BEES IN THE WILD STATE

THEIR HOMES

Man has undoubtedly increased the numbers of bees, but has not done much yet towards producing an artificial strain of bees, a strain as different from the wild bee as the Friesian cow is from the primitive wild cattle. He selects from their various natural strains the qualities he wants for different climates and conditions; bees whose queens are very prolific, bees which start to breed early in the season or late in the season, as the case may be; bees which swarm freely and those which swarm less freely. He makes his selection, and he tries with more or less success to keep his bees true to type. But the great development of the last 200 years has been in technique, not in breeding. In a modern hive the bees are get-at-able. You can at any time during the summer take their nest to bits without harming it or them, you can examine it in detail and see what progress they are making and what their plans are. You can forestall a swarm and prevent it issuing, detect queenlessness or a failing queen, and put your finger on a hundred and one troubles which remained mysteries when hives were just skeps or boxes. But when you get tangled up, as all beekeepers do now and then, in your complicated equipment, it is well to remember how bees manage for themselves and did manage long before our ancestors had brains enough to interfere with them.

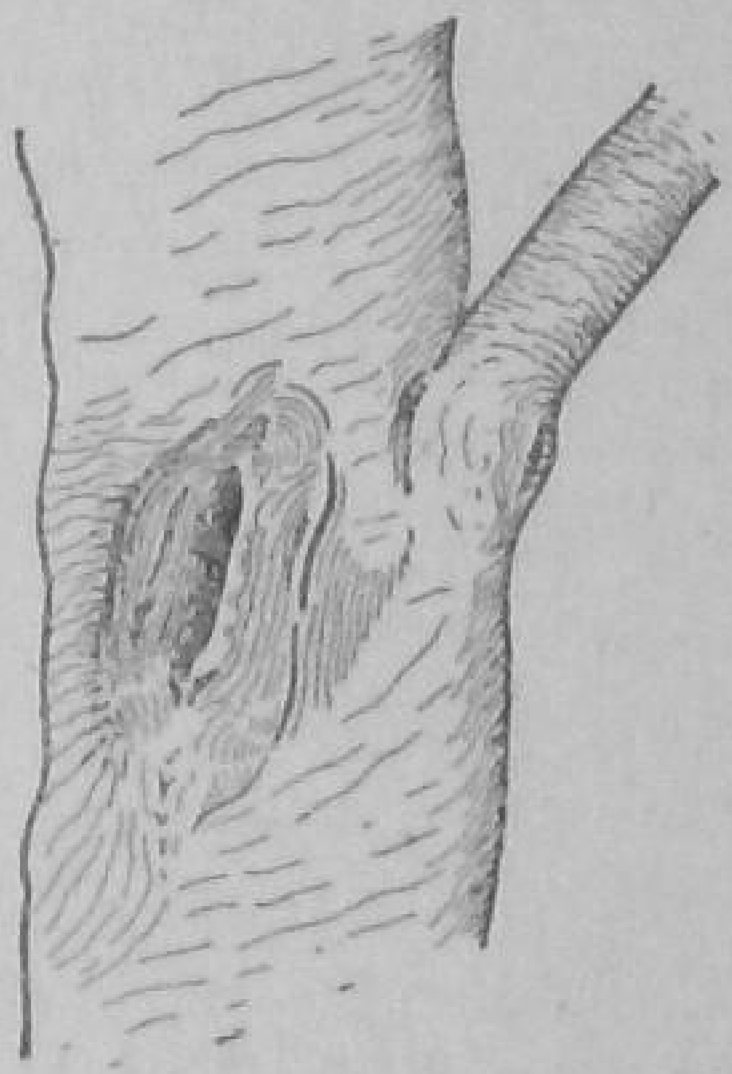
In the British Isles the wild honey-bees live mainly in hollow trees and odd cavities in buildings. What they look for is a considerable hole (at least a cubic foot) with one or more small entrances. They do not seem to mind

if the hole is a great deal bigger than they need, as their fondness for disused chimneys shows. Occasionally they get into very odd places, such as inside the glass of a street lamp or in an iron lamp-standard, in an upturned flower-pot, or even in the room of a house. When they can find nothing better, they may even set up house out of doors, but these will not survive the winter, and even in summer they are likely to have their honey stolen by wasps and by other bees. Still, they sometimes manage fairly well for a time. I once took a colony that had been hanging in a tree for a month and had built enough comb to fill a hive.

Once they have occupied a hole, even if they die out or are removed, the hole remains attractive to bees, and another swarm is likely to establish itself in the same place. The beekeeper can make use of this fondness for old nests by leaving an old hive about with some combs in it. He will quite often catch a swarm, either a wild one or his neighbour's. Some people are shocked at this proposition, but there is nothing immoral in it. Once the swarm has flown away it is good that someone should get it. Otherwise it will only go to the woods or get into the church clock. But he must make sure that the hive is not too smart-looking and that it does not smell of paint or creosote, for these are human affectations with which the bee is not in sympathy.

Sometimes a colony will live in the same nest for many years without accident, but sometimes, when you are told there have been bees in a certain tree as long as the oldest inhabitant can remember, there have in fact been one or two changes of tenancy. Undoubtedly there are a great many casualties, because the number of wild stocks does not increase, although each stock probably throws one swarm a year on the average, and also many swarms leave beekeepers' hives undetected and join the wild bees. In

many parts of the country lack of suitable homes keeps down their numbers. Wild bees are very rare in treeless districts, although these may be good honey districts. But their worst enemy is the weather. Wet, sunless summers prevent the swarms from storing enough honey to see them through the winter and spring. When the beekeeper has to rely on sugar the wild bees die. Only the really well established stocks with two-year-old honey in reserve are safe after one of our more inglorious summers. And



1. *Typical entrance to honey-bees' nest in a hollow tree.*

hard winters kill off the weaker stocks, especially those that are exposed to the wind. Most devastating of all is a hard winter following a wet summer, as happened in 1946 and 1947. The wild bees were knocked right out by the double blow, and would have taken many years to recover their numbers without the help of hive-bred swarms, and many of the hives, too, were empty in the hot summer of 1947.

I do not think that the bees favour any particular variety of tree, except that some kinds are more likely to provide the sort of hole they need. I have seen them in Ash, Oak, Apple, Beech, Pine, Acacia, and Cherry, but

never so many stocks in so few trees as when a row of Black and Aspen Poplars were felled. They were all high up in the crotches, far out of human reach. And in buildings they show no special preference for wood or stone.

THEIR SEASONS

Most of this book is about meddling with bees, interfering with their natural behaviour, sometimes gently and sometimes drastically, so as to increase their chances of survival and of storing honey. But before I describe the beekeeper's year, I would like to say something of the bee's year. We might start with a wild stock which is preparing to swarm in early June, and follow its swarm through a season.

Since bees are social creatures, living in a community with only one reproductive female among them, their increase must be something out of the ordinary. They cannot increase by sending *individuals* out into the world, for the only individual who would be of any use is the queen, and she is so specialized that she cannot live alone and found a new nest. Wasps and many bees other than the honey-bee increase by producing a number of young queens in the autumn. These are mated by the drones, and leave the nest to hibernate. In the spring the surviving queens each found their own nest, and they are not so specialized that they cannot do the work in the early stages and produce the first batch of workers unaided. But a queen bee is designed to lay an enormous number of eggs – even 2000 a day – and she can do nothing else. She cannot hibernate or start a colony on her own, so increase has to be achieved by splitting the colony in half and providing a new queen for one of the halves.

The colony we have in mind is a fairly strong one, made up of one queen, who is probably one year old, a few hundred drones who have all been born since the end

of April, and about 30,000 workers, the oldest of whom is about eight weeks old. Their nest consists of about ten or twelve combs fixed to the roof and sides of the hole in which they live, and hanging vertically downwards roughly 1½ inches from centre to centre. They are perhaps 18 inches long, or even longer if the hole is narrow. Most of the comb is made up of worker-cells, cells of the right size for rearing those stunted females which come from the same egg as the queen and which are a compact of devices for getting every job done except only reproduction; a sack for carrying nectar from the flowers, baskets of hairs on their legs for carrying pollen, glands for preparing the milky food of the young grubs and the special food of the young queens and drones, competent jaws for all purposes, and the power to make wax sprout from their bellies – wax which allows air-tight storage, and is one of the main secrets of the honey-bee's success. But here and there are patches of the much larger drone-cells. The centre of the nest, probably the lower centre, is mainly filled with brood in various stages of growth, eggs like little grains of rice stuck to the bottom of the cells, small half-moon-shaped larvae a day or two old, each swimming in its pool of food, the older larvae, glistening pearly white, curled up so tight that they look uncomfortable in their cells, and the pupae, the chrysalids, under their brown porous cappings. The brood is not scattered about the combs, but kept compact, more or less in the shape of a ball: it is kept warm at round about blood heat, and the compactness economizes the heat. The upper parts of the centre combs are stored with pollen and honey, and the outer combs are partly filled, with large patches of pollen immediately beside the brood. The pollen is a medley of colours, clear yellow from Charlock, pale yellow from Hawthorn, orange from Dandelion, red from Horse Chestnut, and black from Poppy.

This stock is preparing to swarm, so there are queen-cells to replace the queen. The other brood-cells are horizontal, but the queen-cells – crinkly cones with the point smooth and rounded – hang vertically. There may be four or five of them, there may be a dozen or more, some sealed up and others still open, the large larva loosely curled in its palatial cell, and above it more food than it can ever hope to eat.

Before the swarm leaves, scouts are looking for a new home. If ever you are lucky enough to have a swarm settle in one of your hives, you can see the scouts at work. One day one or two bees will be going in and out of the empty hives, the next day there will be more bees, and some of them may even be pulling out rubbish in readiness for the swarm's coming, and a day or so later the swarm arrives, unless its owner catches it. But our swarm is not going to a hive. The scouts find a hollow tree which has not been used by bees before, perhaps a mile from the old nest.

A prime (first) swarm generally leaves the hive or the nest when a queen is nearly ready to emerge from the oldest queen-cell, but bad weather may delay the swarm. A fair interval in unsettled weather will allow the swarm to come out, but if the weather is altogether dark and cloudy, the swarm will wait. If that happens, the young virgin queens are ready to leave their cells before the old queen has left with the swarm, and the bees deal with this situation by keeping the young queens in their cells. When the queens are ready to emerge, they cut around the top of their cells with their jaws until they open like hinged lids. (The top of the cell, where the queen's head is, hangs downwards.) But when they are not ready for them, the workers seem to be able to keep them in, feeding them through the slot.

Sooner or later our swarm gets its fine day or fair inter-

val and comes out. It may be at ten o'clock in the morning or as late as five o'clock in the afternoon. But although it knows where it is going, it does not go at once. Many swarms do not know where they are going, but that does not stop them coming out; but whether they have found a home or not, they nearly always pitch somewhere close at hand. I do not know why this is so, but it may have something to do with the flying powers of the queen. A queen in full lay (and at this time of year she commonly lays over 1,000 eggs a day) would not fly at all, but before the swarm comes off she is prepared for flight by a reduction of her lay, which naturally trims her figure and reduces her weight. Just before the swarm comes off, she has practically stopped laying, but it may well be that she needs a short practice flight and a period without any laying at all before she can make the journey. After all, she has not used her wings for a year. It is not at all uncommon for her to be unable to fly with the swarm because of a damaged wing or something of the sort. In that case she is either lost at once or the bees cluster on her where she falls, and gradually desert her when they find she cannot fly. They return to the old nest, where one of the virgin queens has emerged, and swarm with her, still a virgin, when she is about three or four days old. A second virgin is then allowed to emerge from her imprisonment.

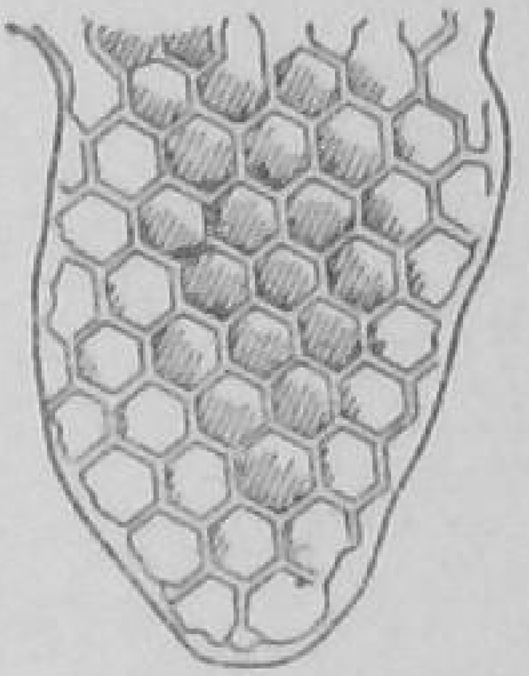
The swarm pours out of the nest in a remarkably short time. It is a headlong, frenzied proceeding, and it is a curious sight to see those bees which are not destined to go with the swarm carrying on with their ordinary work in all the pandemonium. Usually a good deal more than half the colony goes, because the bees that stay have the emerging brood to add to their numbers later, but the swarm will lose numbers for three weeks at least. The old queen goes, some of the drones, some of the older workers (over three weeks old) whose work is out of doors, and some

of the younger workers, who are the nurses, the guards, the house-cleaners, the wax-makers, and so on. They keep in the air for several minutes, and then begin to settle on leaves, tree-trunks, grasses, plants – on anything that stands up. They rest a little while, and then take wing again, and gradually come together in clusters. Perhaps they form only one big cluster which contains the queen; perhaps they do not find her so easily, and form several. But their one idea at this time is to find the queen. The cluster with the queen is quiet, and grows all the time as the flying bees join it, and some bees hum and fan with their wings to show they have the queen, while the other clusters degenerate. They are restless, with bees running all over them and taking wing to search again for the queen. In the end they all hang in one cluster, inert, with only a few bees coming and going. They may be on a tree-trunk, a fence, a wall, even on the ground, but most commonly they are on the branch of a tree or bush, not far from the ground, if the queen is an old one.

If they came off in the morning, they may fly in the afternoon if the weather allows, but they usually wait for the next day. The scouts have been going to and from their new home all the time. The cluster breaks up, and the bees circle round until the queen is on the wing. She may settle again, and they with her, only to break the cluster again a few minutes later. But when the queen is flying they begin to move, slowly at first, and then gathering speed until they are going at a very fast walking or even at a running pace. They pitch at the entrance of their new home, and run in with much humming and fanning, and they gather again in a hanging cluster at the top of the hole. While they are on the wing they make a great noise, so that you cannot fail to hear them even if they are far overhead.

Clustered again, they at once set to work. The field-

bees go to find honey and pollen, the wax-makers cluster tight, consuming the food they have brought in their honey-sacks and changing it into the scales of soft wax that are slowly extruded between the segments under their bodies. The wax-workers fix the new wax to the roof and shape it into comb. The queen's attendants feed her with the special food she needs to make her body heavy again with eggs. Within twenty-four hours, it may be, there are a number of curved pieces of soft white comb, and the queen is already laying her first eggs in them. She walks on the comb and looks into the cells.



2. *Start of naturally built comb.*

Finding an empty one, she slowly lowers her abdomen into it, resting her legs on the face of the comb, and uses that device (which in the modified worker is only a poisonous sting) to place and stick the egg on the bottom of the cell.

For a few days the weather is good. The nest quickly grows. Nectar and pollen are plentiful, and by the sixth day seven or eight combs are started, and two or three in the centre are 10 or 12 inches long, but they are still curved like a horseshoe, and they reach the walls of the hole only at the top. All the lower centre is full of eggs and just-hatched larvae, except for a few cells of honey and pollen scattered among the brood. As the nest grows, the earliest nectar is pushed outwards to make room for the

eggs, and with this handling and evaporation it becomes honey. At first it is perhaps made up of three parts of water and only two parts of the various honey-sugars. Later it becomes four parts of sugar and only one part of water, but it will be a little while yet before any of the honey-cells have reached their full length and been sealed with their white wax cappings.

But on the seventh day the weather breaks, and there follows a fortnight of chilly, showery weather – such weather as often comes in June, and breaks the farmer's heart by wetting the hay time after time, just before it is fit to carry. The flowers are there in plenty, Sainfoin waiting to be cut for hay, Charlock in the cornfields, and White Clover just opening in the pastures; but the flowers are nearly always too wet for the bees to work them. When they are not too wet it is too windy and cold for them to yield much nectar, so the small reserve in the combs of the colony dwindles. For a day or two the bees do not change their tactics. They stop building the outside combs, for there is nothing to store in them, but they go on building where the queen needs the space, and they feed the larvae from their stores. But the larvae are many and the store was small. After three or four days of bad weather there are only 2 or 3 lb. of honey left. At this stage the bees alter or reduce the food they give to the queen, so that she checks her egg-laying. The oldest of the larvae are just beginning to reach the pupa stage, when they are sealed up and need no more food, but eggs are still hatching as fast as pupae are sealed.

From time to time there is an hour or so when the bees can get a little nectar, and often they get some pollen, for a flower does not need to be warm to yield its pollen; but pollen alone will not make the milky food which the nurse-bees secrete for the younger larvae, nor make the balanced ration of honey and pollen – honey for bread

and pollen for meat – which the older ones must have. As the bad weather goes on, more and more drastic measures are called for. Even the few eggs the queen lays are not fed when they hatch, so that they die; when the store of honey is all gone and the bees are living from hand to mouth, many larvae die through neglect or irregular feeding, and before the fortnight is over the adult bees themselves are so starved that they cannot keep the nest at that bloodheat temperature which is necessary for rearing brood. The bees hang together in a weak cluster, moving as little as possible, so as to conserve what heat they have. They even chew at the cappings of the sealed brood, apparently vainly searching for food where they know there is none, or perhaps trying to prevent the birth of the new generation, with its extra mouths to feed. But always, if the sun comes out for an hour and it gets warmer, there are some bees able to fly and find a little food.

It is this discipline in demoralization which saves our colony. The weather changes. The day temperature rises from 60 to 70 degrees, which makes all the difference between no honey and plenty, and the colony is able to pull itself together and start again, although its chances of survival have been much reduced. It has been established three weeks, and all the bees are three weeks older. The life of worker-bees in summer is only six or eight weeks, so nearly half of the original swarm has already perished. Normally the older field-bees as they died would have been replaced by the younger nurse-bees, and the nurse-bees by the newly-emerged brood; but at the best of times there is a great strain on a newly-established swarm for the first four weeks, three weeks while no bees emerge and another week before the first young bees begin to relieve the nurses. True, the colony has some brood from its first ten days of normal rearing, but even some which reached the pupa stage quite normally was chilled

too long during the starvation period, and will never emerge. A good swarm in favourable weather will rear brood very fast during the first fortnight, but much slower during the third and fourth weeks as the population falls and the nurses grow older; for when the nurse-bees are three weeks old, and should really be field-bees, they are no longer good nurses. During the fifth and sixth weeks it will rear brood as fast as any colony, as fast as the queen can lay eggs, and that is why a May swarm will often get a good honey-crop in a warm July.

But our colony, because it will have few nurses for its second three weeks, cannot have anything but a modest population before August is in and the nectar-yielding flowers are over. But, as so often happens after a cold, wet spell in June, there is a long spell of fair weather which combines with the damp ground to make nectar abundant. The little colony cannot gain 10 lb. or more in one day, as a really powerful stock will on rare occasions, but, by gaining 1 lb. or 2 lb. nearly every day through a fair July, it starts August with 30 or 40 lb. of honey in store – enough to allow it to survive a normal winter and spring.

When the bees began to find nectar at the end of June, the queen was unharmed and was quickly brought into lay again. In times of starvation the queen is especially favoured, and if the starvation runs its full course she is one of the last to die. As well as a small amount of sealed brood just beginning to emerge, our colony has one other asset: it has the combs which it built in the first ten days. Combs are made of wax, and wax is secreted by bees consuming nectar, and it is an expensive process. Even a fairly small colony will have a pound of wax in its combs, and to make it the bees will have consumed nectar which might have become perhaps 8 lb. of honey. So a day or two of the short remaining season is saved, because half the combs are built – half, that is, of the limited comb

that will be needed this season. Around Midsummer Day a really strong stock may use as much as 20 square feet of comb (counting both sides) for brood alone; our stock, short of bees and with midsummer already past, will need hardly 4 square feet for its brood. And as the brood is reduced at the end of the month, the brood-cells are used for winter stores, and no more comb is built on the outside of the nest. At this time perhaps six combs of an average size of 1 square foot (12 square feet of comb face) hold the brood-nest, the 30 or 40 lb. of honey, and the 5 or 10 lb. of pollen which are scattered about, mostly topped up with honey and sealed against moulds.

In the brood-nest there is no substantial emergence of new bees until 20 July, and no adequate supply of nurses until 1 August. But because the queen was checked in her laying before, and since the end of May has never been allowed to lay to her full capacity, she will make a little final spurt, and lay more eggs in August than she would otherwise have done. Young queens may lay as late as October, but our old queen will probably stop at the end of August. By this time the colony is well into the long period when it must live on its capital, without any hope of even a small income until April. If it tried, by rapid breeding in August, to bring its strength up to what it might have been had the weather favoured it in June, the warm days and plentiful pollen of August would allow it to do the job, but it would run the honey store so low that the bees would be almost sure to starve in the spring. Chances are better if the population is smaller, and even the little spurt which our queen makes is risky if August is wet. Unless Heather or some special crop (such as second-cut Red Clover) is available to the bees, the end of July marks the end of honey surplus, but in fair weather in August they will usually get enough to live on. In autumn bees are very reluctant to breed if they have no income;

in spring they spend their capital gaily, and even over-spend it.

But August is fair for our colony, and they rear, without loss of honey, a good batch of bees which will stand them in good stead in spring. For these are the nurse-bees of the spring brood. During the full winter period when no brood is reared – which is roughly the five months from September to January – the bees do not hibernate, but they are held in suspense. They do not let the temperature of their bodies drop to that of the winter air, or they would die, but neither do they keep the warmth of the summer cluster, which is above 90 degrees. They keep a temperature which is just enough to let them live with the least possible expenditure of food – about 57 degrees in the middle of the cluster. The colder it is, the smaller and tighter the cluster becomes; with warmer weather it expands, and the bees fly out to cleanse themselves if the outside temperature reaches 50 degrees. During this time our colony is clustered on the empty combs in the lower centre of the nest, over the cells from which the last of the brood emerged, and the empty cells of the combs which intervene are filled with bees, so that only the thin wax walls break the compactness of the cluster. Very little food is needed to maintain the modest warmth; the colony is only 5 or 10 lb. lighter in January than it was in September. The food is above and around the cluster, and they move gradually upward as they consume it.

During this time the bees grow older, but to a great extent their ageing is also in suspense. If it were not so they would be all dead before Christmas. A bee which emerges in June spends her first three days in cleaning out cells, then feeds the older brood until, about the eighth day, she can make the milky food for the younger larvae, and she remains a nurse until she is about a fortnight old. She then engages in all the other indoor jobs – wax-making and

working, comb-building and house-cleaning, and finally in guarding the hive against enemies – until, at three weeks old, she settles down for the rest of her life to the field work of carrying pollen, water, and nectar. Often pressure of circumstances alters the relationship of age and task. As we have already seen, a swarm has no young bees emerging, so the nurses must nurse longer, and to a certain extent they can do it if they must, though they do not do it well. By the time they are five weeks old they are probably quite useless as nurses. But the autumn bees, having no brood to nurse when they emerge in August and September, are fully competent to nurse the spring brood, and these late bees, having no age in them when they go into the period of suspense, are far more likely to survive the winter than those which were already field-bees in August.

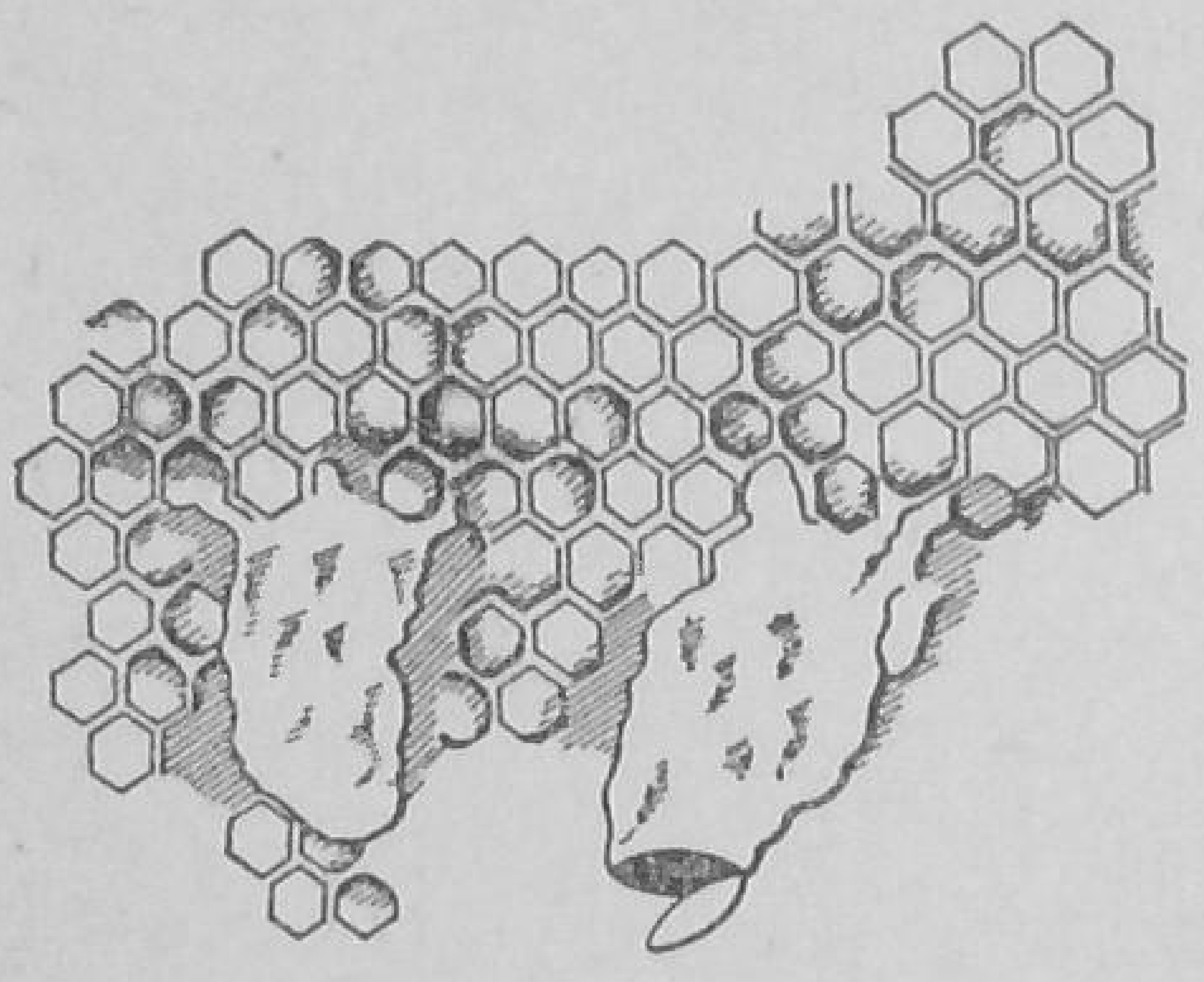
Our colony, then, thanks to the late spurt of the queen, has no large numbers, but there is a good proportion of young bees among them. The winter is normal, and with the first mild spell in January they begin in a small way the big task of building up to summer strength. A little sphere in the centre of the cluster is raised to brood-rearing temperature, and the queen begins to lay. Each mild spell prompts a growth of the new brood-nest; each cold spell brings a struggle to hold what has been won so that it is large enough for full replacement of the population early in March and the numbers of bees emerging begins to exceed deaths early in April. At first both honey and pollen must come entirely from the stores, and it is only with the greatest difficulty and risk that water can be got, in the milder intervals, to thin food for the brood; but from the beginning of February there is pollen to be had on the rare days when the bees can work. Nectar does not come in at all, and the store of honey is eaten at an increasing rate. A great deal is used simply to keep the

brood-nest warm against the winter temperatures outside, and as the brood-nest grows, so do the demands for both fuel and food. This makes March the most critical month of all.

But I will not inject any more disasters into the history of this colony. It very nearly came to grief in its first three weeks. I will leave it to build up for a prosperous summer. But my purpose is to give a very small picture of the normal behaviour and the normal hazards of a colony, and I must make the picture a little more complete by mentioning a few of the things that might have happened during this or some other season.

THE SWARMED STOCK

Our colony started as a prime or first swarm. When the swarm left home with the old queen, it left behind it a



3. *Worker, drone, and queen-cells, showing the hinged cap which is usually left after the queen has emerged.*

good number of bees, a quantity of brood, some sealed and some unsealed, and perhaps a dozen queen-cells almost ready to produce their queens. This, the parent colony, will decide whether to swarm again or not, and the decision will depend a little on the weather, but mainly

on the inborn character of the bees. Whether a particular strain of bees is given to swarming or not is very important to the beekeeper; and it is also an important factor in determining which wild strains are best able to survive. The extreme example is a strain which hardly ever swarms. This would mean very well-found stocks which would not be likely to starve, but would leave no successors if they died through disease or queenlessness. At the other extreme is a strain which swarms itself to death, dividing itself so often that neither the parent stock nor any of the progeny is strong enough to survive an unlucky season. If the parent stock decides not to throw a second swarm, the first virgin queen to emerge is allowed to kill her sisters. This always seems to me a most peculiar weakness in the honey-bee's system, because the life of the colony then hangs entirely on this one bee. If she is in any way imperfect, or anything happens to prevent her mating and starting to lay, there is no means of replacing her, and the colony perishes; while if one of her sisters could be kept alive as a second string, the colony would survive. Many colonies, and not only wild ones, do perish by this fault.

The virgin queen when she emerges is large – as large as a laying queen – and she looks soft and pale if she has emerged at the usual time, which is about the sixteenth day. She quickly sets about her sisters, tearing holes in the sides of their cells and doing battle with any that have come out in the meanwhile. Queens fight with their stings, so that the survivor is uninjured, and it is almost impossible for the last survivor to be crippled, even if she has fought a number of battles. So long as she has rivals in the nest, the queen makes a loud call on a high note, so loud that it can be heard several yards away: pee–p, pee–p, peep, peep, peep, peep. The rivals answer in the same way, and even make a more muffled version of the call if they are still confined in their cells. She is so

absorbed in her jealousy that if you can take out the comb on which she is, she will go on peeping, and you can watch her wings trembling as she makes the call.

In about twelve hours or less from the first emerging there will be only one virgin queen. As she gets older her colour becomes darker and clearer and she gets smaller. When she is four or five days old she begins to fly if the weather is fair, and she may now at any time meet the drone and return mated to the nest, carrying with her as evidence a fragment torn from the body of the drone whose brief good fortune it was to discharge his only function. About thirty-six hours later she will begin to lay, and if the weather is good she will usually be found laying between eight and twelve days after she emerges.

But if I may go back to the parent colony whose swarm so nearly died in that depressing fortnight, we shall find another disaster. The stock decided not to throw a second swarm. Two days after the swarm had gone there was only one virgin left, but on the seventh day, when the weather broke, she was not yet mated. For fourteen days it was never still and warm in the middle of the day, and she could never fly to mate; after that it was too late, and a few days later she began to lay unmated. These eggs, though laid in worker-cells, grew only into stunted drones, many of whom died before they developed. Realizing the fault of the queen, the bees tried to rear another, but got only an over-sized drone in their queen-cell. By the end of August they were too weak to defend their stores against other bees and wasps, and were finally overcome and stripped of all their honey in one day by a more fortunate neighbour.

CAST OR SECOND SWARM

I will suppose now that the parent colony did decide on a second swarm, and that one of the queen-cells was several

days older than the others. The first virgin to emerge would not have been allowed to interfere with the other queen-cells. As soon as she started flying, the second swarm would have gone off with her, unmated. If any of the other cells had reached the point of emergence before she went, their inmates would not have been allowed to come out, and there would have been a chorus of peeping, but no fights. The second swarm, having no stores, might well have died of hunger in the cold fortnight which immediately followed its departure, but if it managed to live from hand to mouth – since it would have no brood to feed – its queen would be too late to mate, and it would perish. The virgin remaining in the parent stock, however, would have a chance of mating when the weather cleared. She would come into lay about twenty-one days after emerging, which is just about the limit of lateness. So in this case the parent stock might survive, but it would be a small, weak thing before any brood started to emerge at the end of July.

DRONE-LAYING QUEENS

The determination of sex in bees is very peculiar. The queen usually mates only once in her life, and the sperm from this mating is stored in such a way that a little can be given to or withheld from the egg as it passes. She makes in her ovary only one kind of egg. If it is fertilized from the stored sperm it is female, and makes a queen or worker; if it is unfertilized it is male, and makes a drone. Thus the female has a father and a mother; the male has no father but its grandfather. And so the virgin queen who missed her mating lays drone eggs, as also does the old queen whose stock of sperm has run out. Fortunately, the old queen does not usually start suddenly to lay only drone eggs. If she did, her colony would probably be too late in discovering the trouble and building queen-cells,

for the larva must be less than three days old if the special feeding is to make it into even an indifferent queen. She peters out, laying some male and some female eggs in the worker-cells, and so gives her bees a chance to replace her if she fails between April and September, while drones exist and queens can fly to mate.

LAYING WORKERS

When a stock is hopelessly queenless, one or more workers will most commonly start to lay. They lay in a messy way, which is fairly easy to distinguish, for the eggs are scattered, and often many are in one cell, especially in drone-cells and the little bases of queen-cells which are to be found on most combs. Except in very rare cases, the eggs produce drones only. Good queens lay several eggs in one cell only when the cluster is small and limits their scope. Reports of stocks which have re-queened themselves when hopelessly queenless have led many people to presume that bees will sometimes steal a female egg from another stock when they urgently need it. If they did this it would argue that they have some reasoning power, for which there is no other evidence. There are two other explanations to account for the undoubted fact that these hopeless stocks do sometimes get themselves a queen. One is the entry of a small swarm or even a lost queen (virgin queens are often accepted by queenless stocks, although fertile queens are not); the other is the production of an occasional female egg by the laying worker or drone-laying queen. I have several times seen these females in the brood of a queen that, to the best of my knowledge, was not mated; but it is not possible to say that these queens had not had some unsuccessful sort of mating. The laying worker is such a nuisance that the beekeeper rarely waits to see what its eggs will do, but it is not unreasonable to suppose that it sometimes lays a

female egg, since in some other species of bee that is the rule, and not the exception.

SUPERSESSION

The bees have a better way of replacing an old queen than waiting for her to fail, with the risk of winter queenlessness that that involves and the certainty of a gap in brood-rearing. They rear one or sometimes two queen-cells without any of the usual preparations for swarming. The virgin emerges and mates without quarrelling with her mother, and starts to lay amicably in the same nest, though after a week or two the mother disappears. This supersedure of the old queen most commonly happens in late summer, after the middle of July, when the impulse to swarm has died away, though it is not rare in spring. But if the stock is strong enough to swarm, spring supersedure is likely to cause a swarm; the one queen-cell is followed by others, and the old queen goes off with a swarm, and is superseded later on. During the full swarming season, from mid-May to mid-July, replacement of a failing queen is practically bound to cause a swarm unless the stock is too weak or is itself a newly-established swarm.

Unfortunately, this excellent habit of supersession cannot be relied on by the beekeeper. Some strains of bee will do it frequently, long before any fault is evident in the queen, while others will not do it even when the queen is old, battered, and past praying for. A queen's useful life, like a worker's, seems to depend largely on the amount she has to do. If she heads a strong stock, her prolificacy declines after the second season, if not after the first, and she is unlikely to live more than three seasons, but she may live longer if she has not been called on to lay at a great pace.

DRONES

Drone-brood begins to appear about the end of March or beginning of April, and reaches its maximum just before the stock might be expected to swarm. The bees are very determined to rear drones, and whatever is done to prevent them wasting their efforts in rearing far more than are needed, they will still find space for several hundred. Weak stocks are later in starting. After the middle of June drone-brood falls off fast, and stocks with young queens (where there can hardly be any supersedure) rear practically none at this time. But since some drones go with the swarm and some stay behind, there will be some in every colony until the bees kill them off, usually during the first two weeks of August. If a colony is queenless or is superseding, or if the queen is failing, it keeps its drones, and some of them may survive the winter if the colony winters without a fertile queen. In districts where there are a good number of stocks there are usually enough drones to mate queens right through September. The latest I have ever had a queen mated is 1 November and the earliest 18 April. But chances are not good from 20 September to 1 May, because a still, warm day may not come during the queen's mating period.

Chapter II

SIMPLE BEEKEEPING

The simplest form of beekeeping, which is still practised a little in Britain and much in many parts of the world, is to let the bees look after themselves, to find their nests and steal their honey without any regard to their survival. It is a method which cannot produce much honey, because it kills the goose that lays the golden eggs, and belongs really to that period of human development – the hunting period – when very few men lived in a very large territory and Nature could take care of their depredations.

The next stage, which we call skep beekeeping, has persisted with only slight variations right through man's farming history, and is still probably the commonest method of keeping bees in the world today. Though skeps are getting rare in Britain now, skep beekeeping is still practised by many people who start out with a modern hive and good resolutions, and then let their management degenerate so that the devices of the hive are rendered useless. The principle is to let the bees live as they live in the wild state, but to get control of them by providing homes for them, and so fixing them in a convenient place where they are both comfortable and accessible. The honey is still got by destroying the heaviest stocks and taking their stores, but replacement is provided for by catching and hiving the swarms. For this beekeeping two very simple techniques only are needed: to make the hive and to catch the swarm. No real knowledge of the bees themselves is needed, as is shown by the belief, which was usual until two or three hundred years ago, that the queen was a king who laid down the law and led his armies into battle, which is a nice example of the 'human' fallacy mentioned in the Introduction.

Long after the keeping of bees by the skep method had settled down into an ordinary farm routine, fantastic ideas about their origins still prevailed. There was the ethereal school, who held that bees were heavenly creatures and had no need of the ordinary methods of propagation, and the earthy school, who were deceived by the drone-flies which hatch from carrion maggots, and held that bees could be produced at any time by half burying or bricking up the bodies of animals. It may be that Samson was of this school. But they knew all about swarms, and that they came out of hives. Presumably it was the stray ones which came from other sources. They caught and hived their swarms in much the same way as we do nowadays, with the addition of a certain amount of magic, which was mainly directed towards making the swarm settle, such as the beating of gongs, in which some British beekeepers still believe, in spite of the scientists' doubt whether bees can hear at all.

Naturally, in skep beekeeping the most important thing was to notice and to catch the swarm, because you had to have a replacement before you could slaughter a colony to get your honey. It was easy to keep the bees in a place which was always being overlooked, and so make fairly sure of noticing the swarm when it was in the air; but not so easy to make sure that it pitched in a place where it could be got at. This pitching of the swarm is really determined by the age and condition of the queen. A first swarm is led by a heavy old queen who has only just stopped laying, and it usually pitches within ten minutes or so in a fairly accessible place; but a second swarm is led by a flighty virgin queen who may want to try out her wings, and it is quite likely to pitch in the top of a tall tree or to travel, with or without intermediate resting-places, several hundred yards before it settles for the night. Two things will make a restless swarm settle:

the approach of evening or a shower of rain, so if you want to try any of the battery of tricks which have been used, try an artificial shower. The watering-can, which is sometimes recommended, will hardly get the water where it has to be, but if you use a hose with a good pressure and the right nozzle, you may have some luck.

The hives used in skep beekeeping vary from place to place, according to the climate and the materials available. The hollow log is perhaps the most obvious, because it is suggested by the bees' own common choice, and a vertical log cut from a tree with the wild stock in it can be the foundation of the apiary. Logs are used vertically and horizontally, and easily lead up to boxes of various shapes. In countries where wood is scarce, earthenware crocks, like large inverted flower-pots, make a fair alternative; but in damp climates this material is rather cold and clammy, and the true skep of wickerwork or twisted grass or straw is better. In all these hives it is usual to provide some extra support for the combs; in the case of the true skep this can take the form of a few sticks pushed right through from side to side. The hollow log generally gives way to the box hive wherever the power-driven saw makes cheap plank available.

Fundamentally all these hives are the same except in one particular – size; and the size is governed by the average yield to be expected in any place. Since the idea is to get a hive full and then rob it, there is no point in having it too large. The common British pattern is therefore rather smaller than most.

The destruction of the heaviest stocks takes place in the autumn. The bees are suffocated with sulphur fumes so as to separate them cleanly from the combs. The combs are cut up to get rid of any brood there is; the honey-comb is crushed and pressed through a strainer to separate the honey from the wax and pollen, and the sticky residue is

washed to give the raw material of mead. Only the brood and pollen are wasted, and even they may have their uses, if we believe the story of the Russian beekeepers. A Czar once wanted to discover (presumably for his own use) the secret of long life, so he held an enquiry to find out which section of his population lived longest. He found it was the beekeepers, and immediately presumed that honey was the life-giving food. A more detailed enquiry to find out how much honey it was necessary to eat revealed the alarming fact that all the beekeepers were far too poor to eat any honey at all, and they all lived on the refuse that was left over from their harvest. Perhaps it was the mead that kept them going.

The whole business of this simple beekeeping seems so primitive that it is easy to forget that in many countries, and certainly in Britain, it was a very important branch of farming. Sugar has not been known so very long in Europe, and petroleum is very new indeed. Before sugar there was little but honey and fruit-juice to sweeten anything, and before petroleum all candles were of animal fat and smelt horrid, or of beeswax and smelt beautiful. In countries that had no wine, mead took its place, and it is very likely that imported wine would not have entirely displaced mead in this country but for the shortage and high price of honey. At least the shortage and high price of wine have now, at long last, allowed an enterprising man to start again the commercial production of mead, and in a few years I think we shall all be very grateful for his enterprise.

There are a number of wasteful features about this simple system, though none of them is quite so bad as the destruction of the bees. One is the tendency to destroy the young queens and keep the old ones. The old queens are with the first swarms. If the first swarm came off early and the parent swarmed again, the swarm may be the heavier

stock at the end of the season, but more often the first swarm comes off later (in June), and the parent will be heavier. The second swarms, if they are heavy enough to survive at all, will have young queens, but they may be judged to be too light, and the lightest as well as the heaviest are destroyed. And so, unless supersedure comes to his help, the beekeeper is likely to have too many old queens in his surviving stocks. Further, the system makes for an artificial selection of the strains of bee, favouring those which swarm much, and quickly doing away with those which swarm little; for obviously a stock which does not swarm will be among the heaviest at the end of the season, and it will not leave any of its blood behind. The combs, too, must be destroyed to get the honey, and every new stock must build all its comb, with the considerable cost in honey that this involves.

The whole business remains very largely outside the beekeeper's control. Stocks die out because they are queenless or have gone wrong in some way, and the beekeeper does not know what the trouble is, or, if he does, he can do nothing about it, because he cannot move bees or queens or honey or whatever is required from one hive to the other. He has no say in breeding, and in fact selects against his own best interests. He is always working with half stocks because (unless the swarm is very early) a stock which does not swarm will usually give more honey than the swarm and the parent combined. And any system that depends on swarming is bound to lead to the loss of at least a few of the swarms.

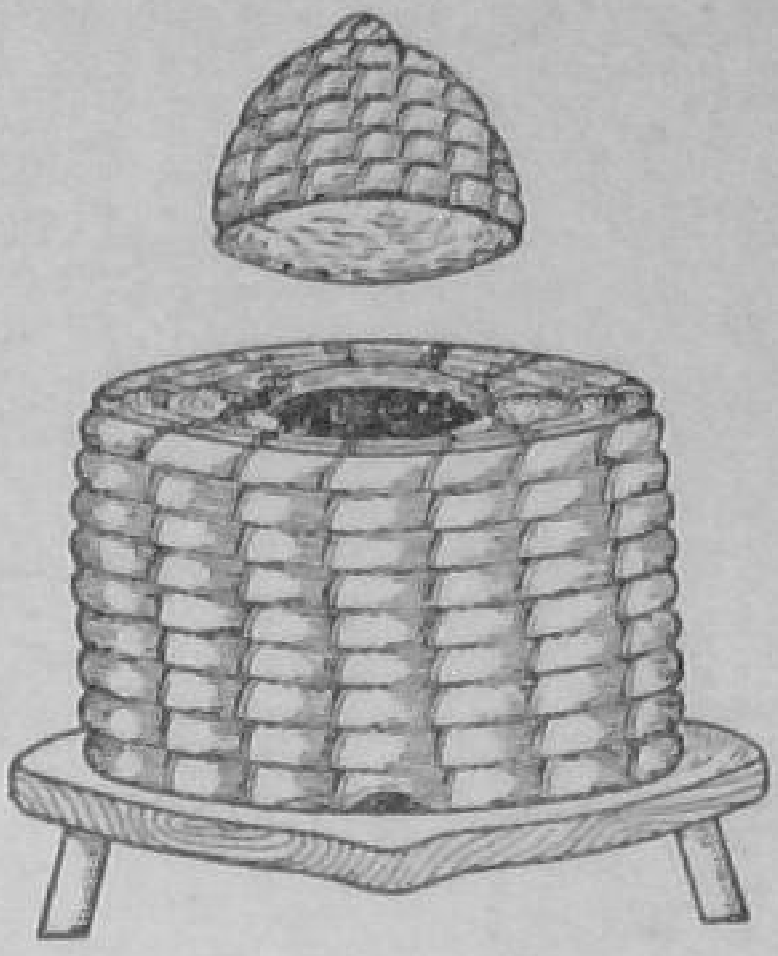
Chapter III

FROM SKEP TO FRAME HIVE

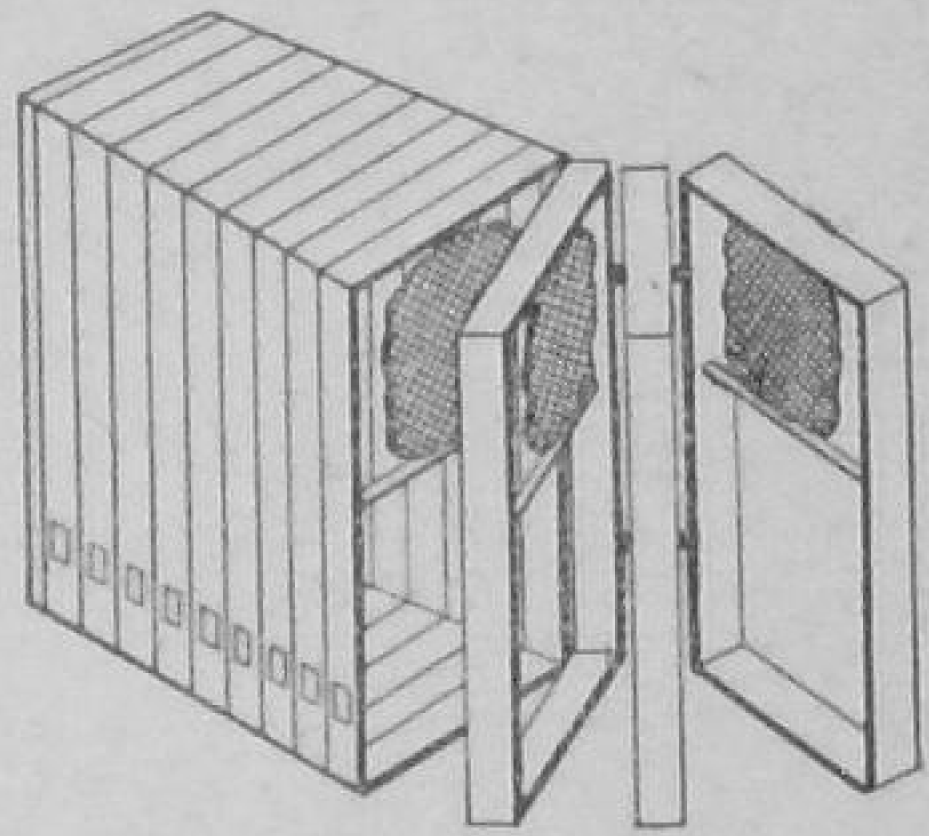
For several hundred years there have been people interested in trying to find out what went on inside the hive, and they used various removable panels of glass and other materials to give them access to the stock, and they built hives of every conceivable shape and size. But the basic difficulty remained the same. To remove a comb they had literally to cut it out. But there was one man who might very easily have caused the modern hive to develop sixty years earlier than it did. Towards the end of the eighteenth century a Swiss naturalist called Huber designed a hive which gave him complete access to both sides of every comb. I can best describe it this way:

Take a rectangular box, with both top and bottom on it, and persuade a stock of bees to build combs in it. The combs must all run from front to back, parallel with the ends. Then saw the box right through between every two combs, so that you have a number of wooden frames, each with a comb in it. Leaving these frames in their original positions, hinge each to its two neighbours right along the back. You then have a sort of book – the Leaf hive – which can be opened at any place. Of course Huber did not make it in this way: the bees would not have been persuaded to build their combs as true as that. He must have got the combs built in the frames by fixing pieces of comb in them and using the divisions which he was able to insert between them.

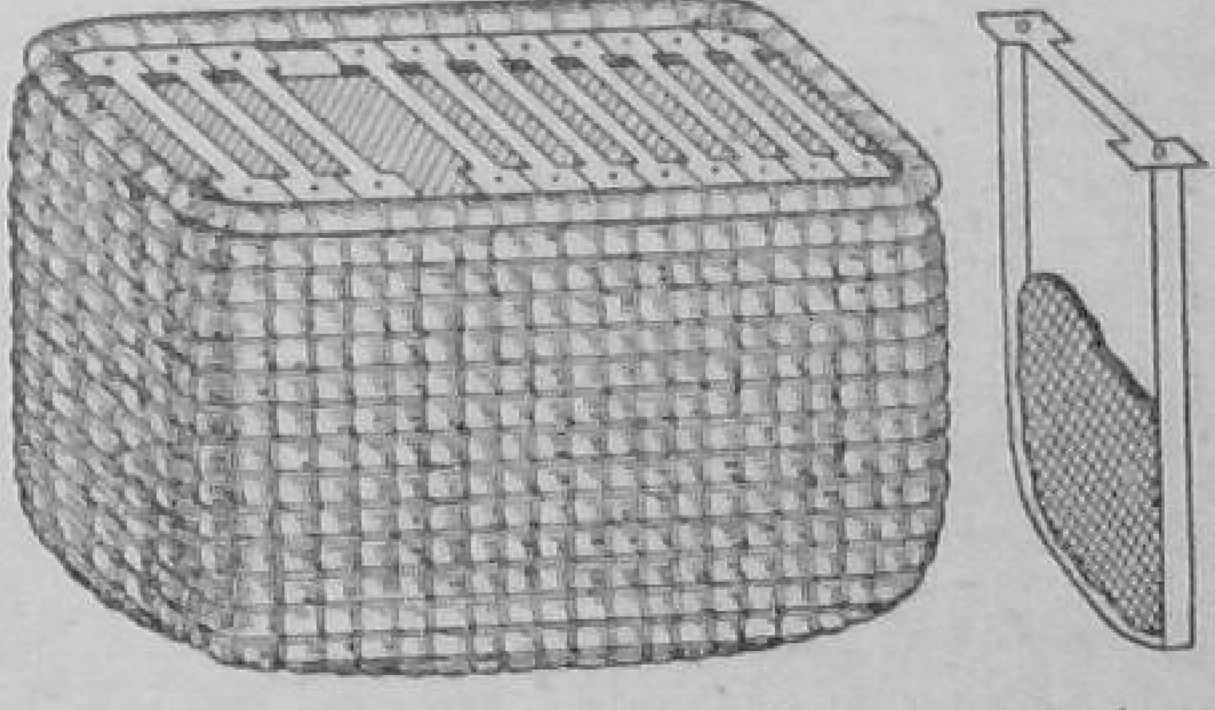
He had means of separating the frames as well as of inspecting them; in fact, he had an important idea, although it was not worked out in a very practical form. I think there is a good chance that if he had been a commercial beekeeper, instead of a blind research worker,



4. *Supered skep.*



4A. *Huber's Leaf hive.*



4B. *An early bar frame hive, upside down. The combs fit close to the sides.*

he might well have taken his idea farther and got it recognized for what it was really worth. As it was, it remained an experimenter's hive.

Even before Huber's time some beekeepers (though not

the general run) were trying to get rid of the most wasteful feature of skep beekeeping, which is the killing of the bees. They made use of the bees' tendency to store their honey above the brood by making a hole in the top of the skep and adding another smaller skep on top. If all went well they could then remove the top skep, chase the bees out of it and let them go home, and leave the colony in the bottom skep to winter. This seems a great improvement, but for some reason it never spread very far among skeppists. Either they were too conservative, or perhaps the queens were inclined to go up into the top skep and spoil the arrangement. Huber used the same idea in his hive by having across his frame a bar which separated the top third from the bottom two-thirds, intending the top section primarily for honey, and the remainder for brood.

Through the first half of the nineteenth century many hives were tried in which the bees built their comb hanging from bars which could be lifted from the hive, but the combs had still to be cut from the sides. There were others in which comb was built in frames something like Huber's, which slid into slots in an outer case. But since bees cement together all loose parts and crevices with the resinous glue called propolis, I can imagine it must sometimes have been necessary to tear the hive to pieces to get the frame out.

The great discovery which introduced modern beekeeping was made in 1851 by the American, Langstroth. It was a thing so simple that one cannot imagine why it was not noticed before. He discovered that bees, while they fill with wax and propolis all spaces less than $\frac{3}{16}$ inch and fill with comb spaces which are more than $\frac{3}{8}$ inch, nevertheless respect and leave open spaces between $\frac{3}{16}$ and $\frac{3}{8}$ inch, which correspond to their natural passage-ways. Consequently, if comb is built in frames, and the frames are hung in the hive in such a way that they clear the

walls by $\frac{1}{4}$ or $\frac{5}{16}$ inch, the frames will not be stuck to the hive except at the small point where the top bar rests on the walls, and even here the sticking is negligible if the support is a narrow metal edge (the metal runners). And if the combs are spaced from $1\frac{3}{8}$ to $1\frac{1}{2}$ inches apart from centre to centre, they will not be stuck to each other, so that they can be quickly removed, examined, and interchanged with each other or with the combs of another hive.

Since Langstroth's invention there has been no substantial new idea in the construction of hives. Everything since has been in the nature of technical development, some good, some bad, and some just complication for its own sake. The hive has settled down as a rectangular box containing from eight to twelve hanging frames, which are meant for breeding and storage all the year round, and another similar (though sometimes shallower) box which is put on the top to receive surplus honey when it is available. The lower box is called the brood-chamber or brood-box, and the upper one the super.

Two other inventions and an important development of the bee-space idea followed, and by the end of the 1860s the stage was set for the growth of the huge honey-production industry in North America. The development of the bee-space idea was a sort of sieve, made by cutting slots in a piece of zinc so as to leave holes large enough for a worker to pass, but not a queen or drone. This is the queen-excluder, which prevents the queen from laying eggs in that part of the hive which is set apart for surplus honey. The space is rather less than $\frac{3}{16}$ inch. A later form is made of wires, which are very accurately held apart. The two inventions were comb foundation and the honey extractor. Comb foundation is a sheet of beeswax passed between rollers so as to leave impressions of the bases of the cells and the beginnings of the cell walls. The bees

build it out into comb very quickly when they want extra space, and it saves them the labour and expense of much of their wax-making. Its midrib is heavier and stronger than the natural midrib, and it is reinforced with metal wires which pass through the frame, so that comb built on it is less likely to break or to fall out of its frame in handling than is natural comb. Most important of all, it allows the beekeeper to get his combs built just where he wants them, fair and square in the centre of the frame. The honey extractor is a device for throwing the honey out of the comb by centrifugal force, which makes it unnecessary either to crush the comb or to eat it in order to get the honey, and allows the same comb to be used for honey storage over and over again. Comb foundation and the honey extractor together so reduce labour and wax-making that they increase the honey output very considerably – many people would say by 50 per cent. I should doubt myself whether it is as much as that, but at the lowest estimates there is still great gain. Although you have to buy the foundation, the foundation-built comb costs no more than the natural comb, and it is a capital asset which lasts many years with reasonable care.

MODERN HIVES AND FRAMES

The type of hive and frame to use is an explosive subject. I am afraid that the primeval medicine-man, who used to concentrate his charms on settling a skittish swarm, has now turned his attention to all the details of the hive, to each of which he gives some magical significance. And as all beekeepers seem to have something of the medicine-man in them (though they are not necessarily given to higher religious exercises, as Raymond Bush suggests in a companion volume), they become very heated when an opposing school calls their particular magic in question. I remember an enthusiastic amateur, who kept a row of

beautiful white-painted hives of the fussiest pattern in his garden, describing a visit he had paid to a commercial apiary. 'He seems to have heaps and heaps of honey,' he said – 'far more from each stock than I've got this year, but I can't understand how he gets any at all from those hives.' 'What's the matter with the hives?' I asked. 'They seem to be made of bits of board nailed together,' he complained. 'And they're as old as the hills, and all the roofs seem to be different, made of any old material.'

You will not get any honey by magic. It is the bees, the management, the soil, the available flowers, and, above all, the weather that will decide your honey crop. Provided you have the basic requirement of movable frames, so that you can manage the bees properly, the type of hive you use will make very little difference to your honey crop, although it may make a good deal of difference to the distribution of the surplus honey in the hive. Some hives will have the honey in the super, and others in the brood-chamber. The real difference between a good hive and a bad hive is the amount of work necessary to manage it and the number of irritations it presents while you are going through it. That, of course, is the commercial man's attitude; the amateur may reasonably say that there are other features which he values more than ease of working, and that his hives are garden ornaments as well as honey-producers, and that they must be tall to be impressive (however hollow they may be); they must have legs and hip roofs.

The majority of beekeepers use what is conventional. In North America the convention was set by the commercial beekeepers of a quickly growing industry, and it is economical to the point of bareness; in Britain, where there was (and is) no industry to speak of, it was set until very recently on lines of extravagance to the point of daftness. But there has been a growing tendency during

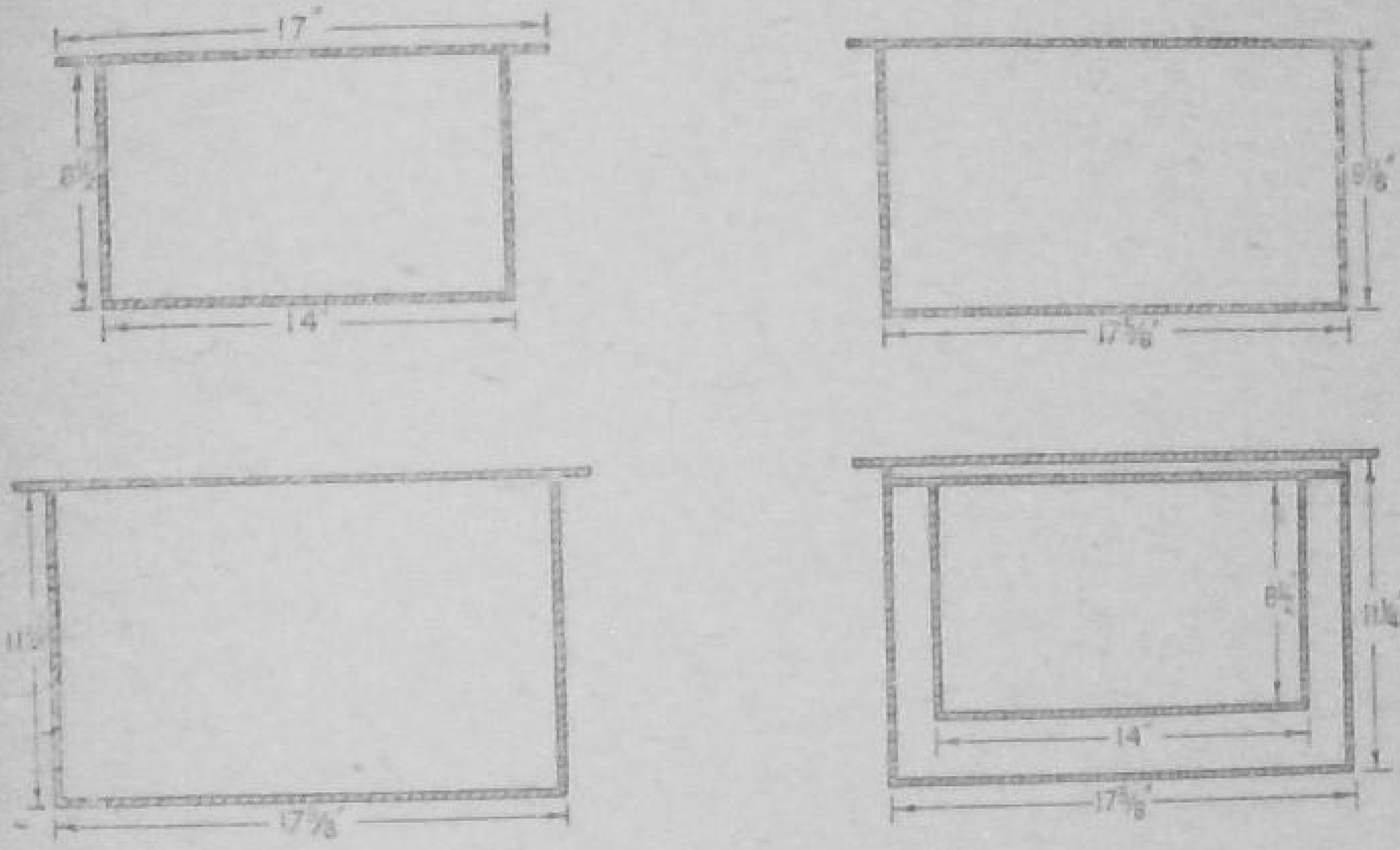
the last few years, prompted perhaps by shortage of timber and high prices, to accept the simple American pattern. Well-made hives last a long time (I have several in regular use which are forty-five years old), so it will be several years yet before the convention is completely changed.

No one looking around the beautiful variety of hives in Britain would imagine that there was anything standard about them. He certainly would not think that the drab little 'Cottager' down the road had exactly the same capacity as this magnificent 'All-Purpose W.B.C., with four Telescopic Lifts', or that that little, squat, new-fangled 'National', sitting like a toad on a concrete block, had a little more capacity than either. The first two are ten-frame British Standard hives, and the third an eleven-frame British Standard. Until very recently the standard referred in fact to the measurements of the frame in the brood-chamber, and had nothing to do with the outside architecture. But in the gradual progress of simplification the Beekeepers' Associations have recently agreed with the British Standards Institute on a few hives standardized outside as well as inside, and a growing proportion of hives will no doubt be made to these standards. The hive is built around the frame, so it would be well to say a little about frames, and to compare one or two common standards, before I go on to the hive itself.

There are dozens of different frames, but only three we need to think about. The illustration gives their size and shape. The Langstroth is, of course, an old frame, and it has become the world standard. I expect there are far more Langstroth frames in use than all the others put together. The British is also an old frame – our version of the Langstroth in the early days of frame hives. The Modified Dadant (M.D.) is simply a deeper Langstroth, and is the second standard in America; I suspect it is now also

the second standard in Britain, thanks to the example of Brother Adam of Buckfast Abbey and the precepts of Mr R. O. B. Manley. Some people in Britain are interested in the Langstroth, but in my opinion it is too like the British for it ever to become our second standard; it has the same fault of being too shallow.

Obviously we want as few standards as possible, because every different type increases factory costs, interferes with the easy sale of stocks of bees, and complicates



5. *British, Langstroth, and M.D. frames.*

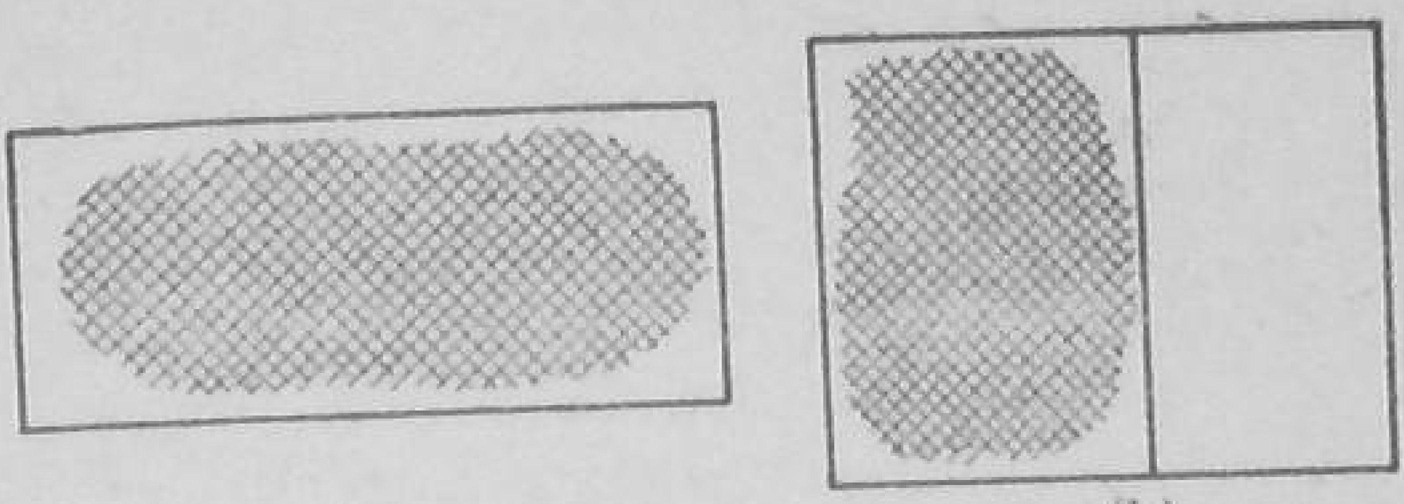
beekeeping, especially if there is more than one type in any one apiary; but just as the engineer standardizes screw-threads but cannot limit himself to one thread only, so beekeepers must have a second standard for special purposes. But what is the matter with the old standards? Why, since it is not likely to lead to any more honey, should we even consider changing?

The Langstroth and the British are both old standards. They were designed for use in single brood-chambers – ten brood-frames with an excluder above them. But they are now too small to hold the whole of the brood at the peak of the season. Queen bees, like hens, lay more eggs

now than they did eighty years ago. So beekeepers on both sides of the Atlantic have to add a second brood-chamber on top of the first. Many of us find that this, though workable, is not satisfactory. Ten (or eleven) frames are too small a brood-chamber, double the number and it is too large. Manipulations take longer because of the extra box to lift and the extra frames to handle; the queen is twice as hard to find, and when the brood shrinks in July the bees are inclined to desert the lower box. The Langstroth, being larger, makes a clumsier double brood-chamber than the British, and if you attempt to get nearer the mark by using a half-depth box (shallow super) on top, you lose the ability to change frames from the top to the bottom section. When the brood is spreading fast in the spring, the expansion may be checked for a few days, especially if the weather is chilly, by having to overcome the obstacles of the top bar of the lower frame, the bee space, and the bottom bar of the frame above. The double brood-chamber is a makeshift, though many would tell you that it is a perfectly adequate makeshift, and that they would not bother to change their standard even if it did not cost them anything to do so.

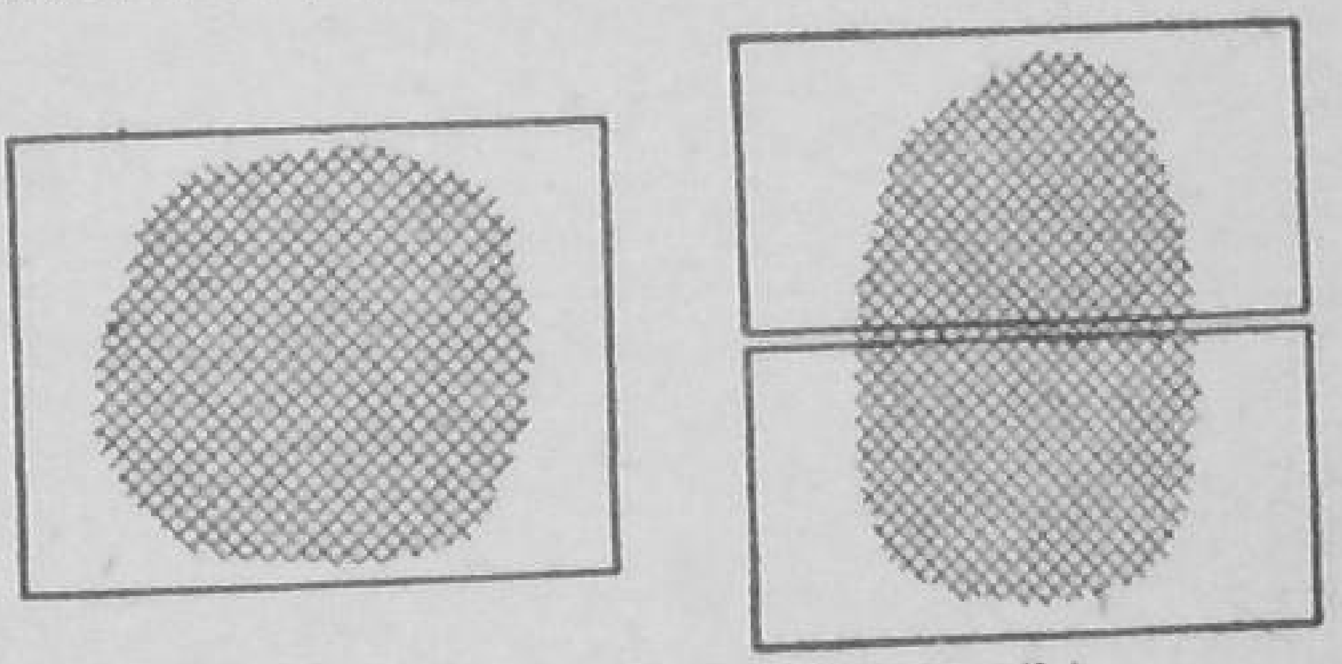
If a beekeeper set out to design the perfect frame without reference to any existing standard, what would he aim at? He would, for certain, be influenced by two things – the shape of the natural brood-nest and the dictates of his own particular system of beekeeping. At the end of last century it was the fashion to use small brood-chambers and to expect the majority of stocks to swarm; now brood-chambers are large and swarms are reduced to a minimum. The designers of the old frames did not allow for the whole of the brood sphere of a young queen laying at full stretch in early summer to remain within the compass of the brood-frames, because such a condition was not the usual one. The M.D. frame allows the brood-

sphere to reach its full height without being flattened or being made to climb over intervening wood-work, it reduces the hive again to a single brood-chamber, with a great gain in the speed and ease of manipulation, and it allows the beekeeper to adjust his brood-chamber to the strength of the stock by using more or less brood-frames, as he sees fit. I have heard the complaint that the big M.D. frame distorts the brood-sphere of a weak



(a) (b)

6. *Summer brood-nests distorted by a limited brood-box.* (a) *Thirteen-frame British hive.* (b) *Six M.D. frames in eleven-frame hive.*



(a) (b)

6A. *Summer brood-nests in unlimited boxes.* (a) *Eleven-frame M.D.* (b) *Twenty-two-frame British.*

stock as badly as the old frames distort the sphere of a strong stock, but it is a harmless distortion. If a stock is on six M.D. frames (which is fully equivalent to ten British), the brood-sphere takes the shape of an egg standing on end – a shape which the bees positively like at the peak of breeding, presumably because it econo-mizes the rising heat; the distortion to avoid is the shape of an egg lying on its side.

I got my first M.D. hives in 1932 (19*s.* 6*d.* each!), and I

other words, the hive serves to keep away the wind and rain, but the real insulator is the bees themselves, whose cluster is so contrived that it lets but little heat escape. The internal temperature of the cluster in mid-winter is only about 57 degrees, anyway.

This only confirmed what beekeepers were finding out in practice; for instance, that the 'Cottager' and other single-walled hives were not necessarily inferior to the W.B.C., but sometimes better. But if you scrap the double walls, why not have something a little less clumsy? Something you can move, if you want to, to the heather or to another district? Something (but one hardly dared to say so then) a little nearer to the American type? So, after a few experiments, came the National hive, a standardized eleven-frame hive after the American style, with a flat, metal-covered roof telescoping over the sides, but still with the double walls front and back to deal with those tiresome frame-lugs. Since then other patterns have been introduced, simplified and standardized in their outside measurements, that come even nearer to the single-walled hive, and it looks as though in a few years time a new double-walled hive will be the exception rather than the rule.

I do not want to create the impression that there is nothing to be said for double walls. Their advantages are not those which were originally claimed for them, and their demerits probably outweigh their merits. But they can be of use in some seasons, especially if you do away with the outer-case idea and make the double wall like a thick single wall. An inch of cork dust is a much better insulator than 6 inches of air. They may not have much effect in keeping the bees warm in winter, but they do protect the brood to some extent in spring and early summer. At this time the bees are sometimes deceived by a long spell of warm weather, and rear more brood than they can protect against a freezing temperature, so that when the frost

does come they leave the outermost brood exposed and lose it. At this time the cluster is at brood-rearing temperature, and really does give off some heat, and a good double-walled hive with a small entrance may save this brood during a few hours of frost.

Dampness can do a great deal of harm in winter, fermenting the stores and rotting the hive. It is worse in single-walled hives of the National type, especially if they are painted, so that the damp cannot go through the wood to the outside. It gets there from the breath of the bees, and sometimes also by creeping up inside the wood of the roof-sides. In the W.B.C. type of hive it is generally dispersed in the outer cases and made harmless. But we are learning to deal with it in the single-walled hive now. Bitumen paint on the roof-sides stops it getting into the wood, and a hole, either through the hive wall or under a supported roof, lets the damp air escape upwards.

The double wall also protects the hive a little against wind, though not nearly so well as a good sheltered position. One might say that if you *must* keep your bees in a high, windy place in winter, then it would pay to use well-packed double walls; but it would probably pay you better to move them to a safe wintering place and keep them in single-walled hives.

It is hard to deny the argument that if we are abandoning the double-walled hive we should also abandon the British frame, which bedevils with extra cost and complication every attempt to design a simple single-walled hive. An increasing number of beekeepers who keep bees on a commercial scale are adopting the M.D. frame, and it is certainly wiser to do this than to shorten the lugs of the British frame, for this destroys the standard without giving the frame a really satisfactory shape. But there should be a word of caution here. I have known beekeepers – one of them a commercial man – who have

adopted M.D. hives and then abandoned them and gone back to British. Their complaint is simple – too much weight. To the ordinary beekeeper a heavy brood-chamber is no disadvantage, since he will probably not want to move it, but the half-depth super of the M.D. hive can reach a gross weight of well over 50 lb., and the brood-frames can approach 10 lb. The super weight is slightly less than the full-depth super of the National. So you would not be wise to start M.D. hives if you prefer British supers to be half-depth (25 lb.), and your wrists need to be fairly strong if you are going to handle a number of these big brood-frames. Even at some personal risk, an assistant will usually come forward when there is a real weight of honey to be handled; but all the same I cannot see these big hives becoming universal. My own comment is that I would rather handle one 50-lb. super than two 25-lb. ones, and the big super is an economy in capital cost, storage space, transport, handling, and in every way; but I strongly object to the excessive economy (imported from America) which provides only hand-holds cut in the thickness of the wood for lifting the super, because these throw the whole weight on to the finger-tips, which is most unpleasant. The apparent weight is much reduced when there are substantial lifting-bars on the sides of the super. But over-weight supers are a rare nuisance, and one not to be treated too seriously.

The standard M.D. hive has eleven frames, but the average queen will not need more than nine or so for her actual brood-nest. I use a twelve-frame hive which was designed by Brother Adam of Buckfast Abbey. I have made the over-sized hive my standard because it allows me to play a few tricks which I find useful but may be only fads of mine. Although the brood-chamber can reach a weight of 130 lb. or more, my system of beekeeping does not require me to lift it when it weighs more than 80 lb. or so.

PART II

MANAGEMENT

Chapter IV

SPRING WORK

Inevitably anyone writing about a technical subject in which there is great diversity of practice must write from his own point of view. He must say what he does and how he would like to do it better; he cannot honestly recommend other systems of which he has no experience or which he has tried and rejected. But any beekeeper who has a long experience and has moved about a little and seen bees in different places is bound to wonder whether the system he has built up for himself, a bit from one man's experience, a bit from another's, and a bit from his own, would not have been very different if he had lived in other districts where the flowers yield their honey at a different time of year. In most places a crop of *surplus* honey is possible only during a fairly short period. There is a good crop if the right weather coincides with this period, but outside it there is not a big enough blossoming of honey-plants to make a real alternative, and the crop is light or there is no crop at all.

I have always kept bees in White Clover districts, where the greatest potential yield is from early June to late July and the peak month is 20 June to 20 July. This is the commonest condition in Britain if you adjust the dates for early and late districts. But there are three other types of country, if I may draw clear lines where the distinctions are really blurred. There is the very cultivated kind of country where there is little pasture and no hedges and the beekeeper has to depend on cultivated crops that flower in the spring and are cut usually while they are in flower – Crimson Clover, Sainfoin and Lucerne. The peak month is 10 May to 10 June. Similar in result is the very different country which is mainly

woodland on an acid soil. It has pasture, but there is little White Clover in it because of the lack of lime, and nearly all the honey comes from trees – Cherry, Pear, Apple (these three may be wild or cultivated), Maple, Sycamore, and, best of all, Holly in the last week of May. The peak is the month of May. Both these very early types of country are difficult for the beekeeper because the stocks do not normally have anything like their full strength of flying bees in May, and because the weather in May, though it is often dry, is not often warm enough for rapid secretion of nectar. Dry, cool easterly weather is no use at all in May, because the temperature is scarcely above 60 degrees, but the same weather in July brings a temperature of 70 degrees, and can be very good. It is rough westerly weather that is the enemy in July.

The very cultivated kind of country does have later honey-flows from second flowerings of Lucerne or from such crops as Mustard, and the woodland country has brambles in July and perhaps some Lime-trees at the end of June, and indeed these secondary sources may sometimes be good enough to make them into first-rate honey districts, but the management of the bees is undoubtedly more difficult. The third type of country without White Clover is moorland country, where there is no spring surplus at all, and the first chance that the bees get is from the Brambles and Bell Heather in July. Here the peak month is August, and the honey comes from the Ling Heather, which is the Heather with the small pink flower: the Scotch Heather. This country is easy from the technical point of view, and can, I believe, be quite good in the North, but in the South there is little true moorland. The moors are rendered useless by a wet August, which is all too common; but the heathlands of the South suffer both from wet Augusts and from dry Julys. The Heathers are at home in Scotland, but in Southern

England (unless the ground is very high, as on Dartmoor) they are almost outside their normal range of climate. When England has a continental summer it defeats them, but when it has a Scotch summer they sometimes yield quite well.

Now, the whole management of the bees depends on the period of greatest potential yield, the main honey-flow. You must do what you can to have the greatest force of flying-bees at this time. Since the June–July period is by far the commonest, I must write as though White Clover is available. Very few people keep bees on moorland only (most of the Heather honey is got by bees moved in from other districts), but those beekeepers who have their main honey-flow in May will need to make all my dates and estimates of strength fit their earlier flow, and they will be skilful if they manage to do so. For the most part, commercial beekeepers keep away from these districts and go where the soil is sweet, with chalk or limestone not too far below; but that is not to say that other soils do not yield good crops. I had my best crop ever on a clay soil which was only just sweet enough to support White Clover, but I believe Bramble tipped the scale in my favour. I would hazard a guess that on sweet soils the clover yields faster than on clay; on clay the bramble yields faster than it does on sweet soils.

However little interference there is from swarming, and however well managed the colony, it has a peak of brood-rearing which cannot be indefinitely extended. You cannot have your brood maximum, which you want just before the main honey-flow, in early May *and* in early June. You must try to work it round to the date that best suits your district, and your success (which at best is likely to be only partial) is one of the tests of your good management. Stocks which reach their peak late in an early district bring no profit, and stocks which are very strong

very early in a late district will probably swarm, and even if they do not they will be past their best when the main honey-flow comes in July. So far as I am concerned, there are two main aims in spring management: to set the bees on the right road to reach the maximum of brood-rearing about the beginning of June, and to do all I can to discourage them from swarming. If I want to divide one stock into two, that can be done later; through the main season the stock must be kept together, if it is to yield much in any but the best seasons.

That is the aim. In giving my opinion of what we can do to help the bees to achieve it, I will write first about work with the bees themselves – manipulation and feeding – and later of the equipment and the routine maintenance work which is done at this time.

WATCHING THE HIVES IN WINTER

In the early part of the winter, before the bees start breeding, there is nothing to be done but to see that the roofs stay on and that mice do not get in. But in the latter part of the winter it pays to watch the bees going in and out on those warm days when they can fly. Before pollen is available (usually about the beginning of February) you may have to waste a good deal of time if you want to see them on the wing, because they are inclined to come out all in a bunch to cleanse themselves; for the rest of the day there is only an occasional water-carrier until the temperature falls below 50 degrees – 50 degrees, by the way, is only an approximate temperature. There is a good deal of variation between different strains of bee, and some of them, especially the black and brown bees, which are indigenous to Northern climates, will fly on a cloudy day with a temperature of 47 degrees. Any bees (especially if they have been long confined and need to fly) will come out when the sun is warm on the front of

the hive, even though the shade temperature may be little above freezing, and in these conditions bees are much more likely to be lost than when it is cloudy and 50 degrees in the shade. They settle out of the sun and very quickly get chilled. It is worse still when there is snow on the ground, because the bright light in some way confuses them.

I often wonder whether we are wise to site our bees so that the sun strikes the hive entrance. It is not a thing which commonly happens when the bees choose their own site. The convention is to face your hives to the south-east or south, but I have never noticed that hives faced to the north suffer at all, provided that they are really well sheltered from the north wind. On the other hand, I have had conventionally sited hives suffer very severely when there is freezing weather with a south-easterly wind, as sometimes during the great frost of February 1947. Hives facing south-west suffered much less, while others in a woodland clearing which got practically no sun at all wintered very well. Of course there are two sides to the question. Bees may be lost by flying on cold, bright days, but they may also be lost by being confined unduly long while they wait for the shade temperature to reach 50 degrees. I rather think that the first is the greater risk, but each winter has its own peculiarities.

The information you get by watching your hives in January or February may be consoling or depressing; but, whatever it is, you cannot make much use of it. There should be no question of shortage of food; but if any stock is suspect, either because it was not properly provided for in autumn or because mice have got in and eaten some of the stores, it does not pay to wait until the trouble shows externally. It will show all right, because the bees will be too chilled to fly when the others do, but by this time the brood will have been lost and all the early efforts of the

colony wasted, even if the whole colony has not already perished. Any suspect stock should be looked at every few weeks by lifting the crown board (inner cover) or rolling back the quilt so that you can see that there is still enough sealed food above the cluster. If it threatens to run right out before syrup-feeding is possible, you have two alternatives: you can either steal two outside frames from a colony that is well supplied and put them one on each side of the cluster (but they must touch the cluster, or the bees may not find them), or you can put a cake of candy on the top of the frames. Syrup is white sugar dissolved in water, and is thinner than honey, although in the autumn the bees evaporate it to the same density and seal it; candy is white sugar boiled with a little water until it sets like a soft, smooth-grained fudge. It is denser than honey, and needs water to make it available, which means that it is a less suitable food in cold weather. It is difficult to make well, often wasteful in use, and is useful only to save the life of a stock which has been neglected in autumn. It used to be a standard commodity, but most beekeepers now have forgotten how to make it, and manage very well without it.

Any winter manipulations of this sort must be done very gently, and without the smoke which is used in summer to control the bees. During the winter there is a vaguely defined period when the bees are liable to kill their queen if they are disturbed. This can happen at any time of year, especially in weak colonies, but it is not common in the summer, nor does one seriously consider the risk in handling broodless colonies in the autumn. The risk is at its greatest in colonies that have a small amount of brood in late winter; it begins to get less about the middle of February, but is still very real, especially in cold weather, until spring is well in.

This disappearance of the queen in winter is a curious

thing. There are no rules about it: it is just a risk, and very often you can only guess at the connexion between the disturbance of the hive and the queenlessness which is discovered later on. I have several times taken stocks from felled trees during the most dangerous period without losing the queens, and nothing could be a more wholesale disturbance than that; stocks which have their roofs blown off, or are even turned right over, often survive without harm; and yet sometimes the loss of the queen can be traced back to quite small disturbances, such as the insertion of frames of food, or even the lifting of a well-propolized inner cover to make sure of the food supply. Whatever the cause, lost queens are a very serious matter, because they cannot be replaced until May.

Apart from saving colonies that would starve, there is one other kind of winter manipulation which may be worth while. It is the saving of the queens of colonies that are so weak that they are going to die out. You cannot do much about this until the risk of the bees killing their queen begins to get less, and a warm day towards the end of February provides you with your evidence.

In any place where there are plenty of Hazel-bushes, Snowdrops, Crocuses, or other early pollen-yielding flowers, a warm day at this time puts the bees properly to work. Any hive which is working with a will and bringing in pollen in large pellets is probably quite normal, and any which brings in no pollen at all is almost certainly queenless. Where the queen has died and been replaced, or where the queen has turned drone-layer during the winter, the bees will carry pollen to feed the stunted drone brood, but they will not be very enthusiastic about it, and the pellets will most likely be small. If there has been a drone-breeding queen for some time, you may even see one of the stunted drones at the entrance, and that is a sure sign; otherwise you must use your judgement

in doubtful cases. A stock which is queenless now, even though it may be fairly strong, is worse than useless if it is left to itself. It will go on eating until April, and then, when it has become too weak to look after itself, it will be cleared out by robbers.

Among the normal stocks there may be one that is very weak. If, when the entrances are busy, there is one where only one or two bees go in and out every minute, then that stock is probably too weak to survive, and will fade out in the next cold spell through sheer inability to keep its brood-nest warm. The stock may not be worth much, but it is worth saving the queen.

If you have a queenless stock and a very weak queen-right (normal) stock, there is no great difficulty in turning the two useless stocks into one good one. Using as much smoke as is necessary, but no more, open up the apparently queenless stock, and go through it to make sure it really has no queen. Even if there is no brood at all, there may be a queen; there may be a virgin that has not yet begun to lay drone eggs. If that is the case, you will probably see the remains of the cell from which she emerged. If there is some drone-brood, you must find the queen and destroy her. Then remove from the hive three or four frames; choose those which have least food in them but not those which the bees are occupying. Push the remaining frames, in the same order as they were before, to one side of the hive and cover it up again. Just about the time when the bees stop flying in the afternoon, open the weak stock – without smoke, if possible. Remove one of the outer frames to give yourself some elbow room and gently lift out, all in a lump, the frames on which the stock is clustered. If it is really weak they will not be more than three. Put them into the space you have made in the queenless stock, and make sure there is at least one unoccupied frame between the two clusters. The queenless

bees will gradually join the other cluster, and a proper brood-nest will develop. There are so few flying-bees in the weak stock that there cannot be much loss if the following day is also warm and some of them go back to the old site.

If there is a queenless stock but no weak queen-right stock, the problem is not so straightforward. If the queenless stock is weak, scrap it or add it to your weakest stock, but do not risk putting a drone-laying queen in with a good one. If all the stocks, including the queenless one, are strong, it may be worth preserving. Wait a week or so until you can open the strongest stock without much risk and get a frame of young brood for it to rear. Later add more brood from the strongest stocks, and let it rear a queen about 1 April, so that it may be queen-right by 1 May. This solution is possible only if your stocks are really strong, and it is quite likely that the queen will not mate and you will have to let the bees rear another.

If there is a weak queen-right stock but no queenless stock, that can be rescued in a similar way. In this case I usually take the risk of examining the little stock at least as far as is necessary to find out whether it is likely to survive the next cold snap. If the brood in the main brood-comb covers an area as big as a saucer and is emerging normally, it will probably survive, and can be left until it is safer to open another hive to get help for it. But if the cluster is very small and there is only a brood-patch about 2 inches across in one frame, you must abandon it or risk the queen of another hive. The risk is not very great if the day is warm. But it is not the simple operation of giving a shaken frame of brood, as in the case of the strong queenless stock above. That stock had plenty of bees to look after the given brood and to keep it warm; this has not, and the given brood would be neglected and chilled. Nor can you, as when you are equalizing later in the

season, give a frame of brood with the bees that are on it. They would outnumber the little stock and kill the queen. You must find in your strong stock a frame which has a brood-patch on both sides about the size of a saucer, which contains few larvae (because there are very few nurses available), and a large proportion of pupae which are nearly ready to emerge. You probably will not get a perfect one, but get as near as you can. Shake the frame, but only hard enough to dislodge half or two-thirds of the bees. When this is done, nearly all the older bees are shaken off, and the younger bees remain; these younger bees are far less likely to attack a strange queen. Take the frame and lean it against the weak hive. Open that hive and take out its one brood-frame; find the queen and pick her up by the wings; put her with the bees on one of the other frames; shake all the bees from the brood-frame back into the hive; put that frame aside and replace it with the frame from the strong hive. Then put the frame with the little patch of brood into the strong hive and close both up. The idea of finding the queen and moving her by hand instead of shaking her off with the bees is that this reduces the chance of her being balled by the bees and killed.

That is about all you can do at this very early stage. Many beekeepers would not agree that it is worth doing this, but it usually works, and if you have few stocks and you value them, it is a pity not to do all you can to see them through. It is commonly said that you should not go through your hives until there is warm weather in April, and that is good advice; my suggestion is only that you should not adhere too rigidly to this rule when drastic measures can save stocks.

TELLING THE AGE OF PUPAE

Inexperienced readers will now, I think, have three questions that I must try to answer. How do you tell when

pupae are near emerging? What do you mean by a really strong stock? What is the 'balling' of the queen?

Without tearing off the capping you cannot tell the age of a pupa except that during the last two days, when the pupa itself changes from white to grey, you can to some extent see the change through the capping. The newer and whiter the comb, the easier it is to see; in an old dark comb it is very hard to see at all. At best it is no more than you would see if you put a thin piece of brown paper on a white wall and then slipped a bit of grey material behind it. Some help can be got from the pattern of the brood. Since winter brood-rearing advances in any warm spell and checks when it is cold, the resulting nest is made up of concentric rings of brood, each ring being more or less of an age, so when one of these rings starts emerging, it is probable that a good many more bees will come from it within a few days.

WHAT IS A STRONG STOCK?

At any time during the building-up period a strong stock is one that is stronger than is necessary to reach the maximum brood rearing of which the queen is capable by 1 June. Since you do not know what the weather will be, and you probably do not know the potentiality of any individual queen, we might say 'the maximum brood rearing of which a good average queen is capable by 1 June in average weather'. This is a precise definition until you look at it again and find that it all depends on what is meant by 'necessary'. Nevertheless, it emphasizes the aim which you must always have in mind during the spring. It is only too easy to put a stock out of the running by robbing it of brood, especially if the effect is to leave it short of nurse-bees later.

When it comes to saying what strength is necessary at any time before a stock can be robbed for the benefit of a

neighbour, I find myself in some difficulty. Beekeeping has no precise rules and definitions; like any other branch of farming, it is a mass of technical skill and knowledge built around an art. A gardener by looking at a lettuce can tell you if it is growing fast, and so can a farmer looking at a calf, but if you merely give them the size and weight of the animal or vegetable, they cannot give you the answer. Show me the stock, and I will make a guess; without it I can only say that there seem to be three factors: number of bees, size of brood-nest, and vitality. This vitality, which allows a stock to work harder and get more done with a given force than do other stocks, is very largely inborn. It is the quality above all others to pursue in choosing stocks to breed from, because you will nearly always find that rapid building-up and rapid honey-gathering go together in the same strain. To spot it in spring, I can only suggest the obvious: that you look for stocks which are making better use of their capital of bees and stores than others which are just as well endowed.

In summer the size of the brood-nest gives a pretty good indication of the strength of the stock, but in spring, especially in early spring, it may be deceptive, because some strains (many of them good ones) build up slowly in March and April and very fast in May, while others build up at a more or less steady rate. Consequently, the size of the cluster comes into it to some extent, although it would not be good practice to rob a stock which was strong in bees but backward in breeding, because that might leave it crippled for want of nurses, in spite of its large cluster. I would estimate the brood nest of an average queen on 1 June as partly filling fifteen British frames or nine M.D. frames. If it could be made into a rectangle it would nearly fill about eleven British or seven M.D. frames. These measurements assume that the queen has been in no way discouraged from 10 May onward either by shortage

of nurses or of food or by a long cold spell. Short cold spells do not matter much, but longer ones, especially if they threaten the huge pollen supply which is needed at this time, are something which no beekeeper can fully counter. About a month earlier, on 1 May, a brood-nest half the size would be enough. Stocks with double brood-chambers should normally start work in the second chamber before 10 May, though they sometimes hang back for a time, flattening the nest in the lower chamber and then suddenly bursting upwards and putting nearly all the eggs upstairs for a week or ten days.

The farther we go back in time the more difficult it is to assess strength by the brood-nest alone, but I like to see some brood in four frames (say a little over two British frames full) if a hive is opened in early April. If you buy a stock in spring it is usually described as an eight-frame stock (British), and has brood in six or seven frames. You will notice that by my standards that is capable of full development if you get it very early in May, but at the end of the month it is not. The date of delivery is all-important.

These are rough guides only; but if you open a hive at the beginning of April and find ten or eleven frames of brood, you can rob that one and know that you are doing it good. If we go into the realm of possibilities instead of probabilities, I would say that the smallest stock on 1 May that has a chance of reaching the goal has about two and a half full British frames of brood. Sometimes stocks which winter as very small nuclei (baby stocks) on three British frames will get up to full strength in time, but a three-frame nucleus bought in May is bound to be late. Being late does no harm, of course, in those seasons when the honey-flow comes entirely in July, but it loses the crop entirely if the flow is mainly in June; but since you cannot predict these things, you cannot plan for them, and must try to have the bees ready for the earliest likely flow.

BALLING THE QUEEN

If disturbed bees are going to attack their queen you will sometimes see them set to work, and if you are doubtful, it is well worth watching for this, because you can save her if she has not been stung. They run after her and snatch at her, and sometimes one takes hold of her and offers to sting. They pile on to her and make a tight ball about the size of a tangerine. Once in the ball, she seems to be safe from stings, and is held there usually until she dies. Sometimes she must get some food while she is confined, because she may live for several days. Occasionally the bees themselves release her, and she starts to lay again. In that case all the beekeeper sees at his next inspection is that the queen looks like a very old queen, shiny and with battered wings, and that several days' egg-laying are missing from the brood-nest. Very occasionally the bees release her alive but incapable of laying. But in nine cases out of ten they kill her.

Their behaviour towards her is almost exactly the same as it is towards a strange queen, although a strange queen is perhaps a little more likely to be stung. And indeed the only explanation that makes much sense of their behaviour is that they mistake their own queen for a stranger. Once some sudden stimulus has fixed this conviction in them, their wretched little minds are quite incapable of realizing what they are doing; they show all the signs of queenlessness, and often start to rear another queen while the old one is still living inside the ball. Since there is no better explanation, it is well to act on the presumption that they take her for a stranger, and do what is possible to prevent them making the mistake.

The queen normally lives with young bees and is fed by the older nurse-bees. Even a completely strange queen is never attacked by very young bees. Balling is most likely

in stocks where the queen is laying, but there is a smaller proportion of young bees than there usually is. It is very rare in honey-flow weather, but quite common immediately after the honey-flow in swarmed stocks which have young queens and in artificially made stocks which have a similar composition. Put these four facts together, and you have two lines of protection against this tiresome waste of queens. Try to avoid manipulating stocks which are short of nurse-bees (as all stocks are in late winter) unless there is a honey-flow. An artificial flow from feeding is not so useful as a natural one, because it does not take the field-bees out of the hive. And secondly, when you are manipulating any hive (especially a weak one) try to avoid driving the queen or spilling her where she is among field-bees only and away from the nurse-bees. So if you are looking for a brood-frame and the queen is on the one you have chosen, put it back and take another, or, if that is not convenient, pick her up and put her among the nurse-bees on another frame. Whatever you do you will not entirely avoid the nuisance, because it sometimes happens without any interference at all, especially when the queen comes home newly mated; and it is not uncommon to find the bees have been balling the queen for several days in a hive which has not been disturbed for quite a long time.

So far as I know, this is the only serious ill effect which is likely to come from manipulating bees, so long as it is done with reasonable care and with that almost intuitive sense of their capabilities which develops in a good beekeeper; but from it and from other ill effects, which are more presumed than real, there has developed a school of beekeepers who practically deny the use of manipulation and have returned almost to skeppism. This seems to be the attitude of '*I* can't make it work, so let's not try to work it.' It is not an attitude which affects those who

run down. Well-stocked brood-chambers will send them up to work straight away in the supers when the main honey-flow begins. Occasionally you get surplus honey in May without feeding at all, but I have never found that a good augury for the main season. More often a good season is ushered in by a chilly May, and only the bee-keeper who has driven the bees hard then will have all the field-bees he wants to get the crop. So feed in bad weather in May if you can; although really cold weather may in part defeat your purpose, the fed stocks will always develop faster than the unfed stocks.

OTHER STIMULATION

The ideal stock needs no stimulation and very little attention before May, but these stocks are not even in the majority unless the management has been conscientious. Careful attention in the autumn and a reasonable winter may mean that as many as 90 per cent of the stocks are neither too weak nor too strong, but usually there is a great diversity. If you visit a small, casually-run apiary in spring you will be likely to find one stock dead, one normal, one poor little thing with an aged queen, and one monster which is ready to deal with a heavy honey-flow in the middle of April. In March you can do little but try to save stocks, even at some risk; in April you can begin the task of bringing your stocks to an approximate equality of strength and stimulating them, if that is needed. Feeding is the only method of stimulating bees which is of any importance, and in this I include maintaining an adequate reserve. There is no need to use complicated feeders that maintain a constant trickle of syrup. A pound or two of syrup given twice a week will have the same effect; bees would hardly contrive to build up in natural conditions if they needed income every day. But two other stimulants are sometimes used, and I should mention

them. It used to be the practice to put out trays or boxes of artificial pollen for the bees to gather. Pollen is a food which the bees need largely for the protein in it, but some of the substances which used to be suggested (flour, for instance) contain so little protein that they would surely harm the brood if the bees took them instead of going a little farther afield to get real pollen. I have never seen an apiary so placed that the bees had no source of spring pollen; perhaps in this respect we are lucky, with our great number of early flowers. In fact, where Hazels grow (and that is more than half the country) the pollen is ready before the bees are able to work it, and they are followed, to mention only a few, by Gorse, Colt's Foot, Butterbur, Daisy, Elm, all the Willows, Lesser Celandine, Dog Mercury, and Anemone. We also have plenty of pollen in the late autumn, so that the hives are well stocked for that critical period in late winter when there may be considerable brood but very little chance of flight. I have seen bees gathering Ivy pollen in November. In some parts of America they have a real shortage, but they deal with it now by catching and storing the previous year's pollen and mixing it with soya-bean flour, which is itself very rich in protein.

The other stimulant is a mechanical one: brood-spreading. The bees do their best to keep the spherical shape of their brood-nest, so if you put an empty frame in the middle of it, the queen will lay eggs in it – she will, that is, if the weather after the operation is warm and if there are enough bees to cover and tend more brood. But if these conditions are fulfilled, the bees would probably have extended their nest anyway, and if they are not fulfilled, one of two things will happen. Either the queen will fail to pass the barrier and lay for several days in only half of the nest, or she will lay in the new comb and the bees will desert some of the outer brood and allow it to be chilled.

If it succeeds you have not gained much; if it fails you have lost a lot, so it is not a good speculation. The only brood-spreading I do is to put an empty frame in its place when a brood-frame is stolen from a strong stock, but even so it is important not to give a dingy frame which has been stored all the winter and will not attract the queen for several days. It is usually best to give the frame immediately beside the brood-nest, which is all polished up and ready for use, or, better still, a frame with just a little patch of brood already in it.

EQUALIZING

I think the reason why equalizing is not common practice is that it is a delicate manipulation; you are pretty sure to have some losses before you get the feel of it. If queens were capable of laying an infinite number of eggs, equalization would still have its use for the control of swarming, but since they cannot, it is the best instrument the beekeeper has to help them all to lay at full stretch through the month of May. If there are two hives, and in one of them the queen is in no way restricted, and lays 30,000 eggs in May, and in the other, because of a shortage of bees, she lays only 15,000, the two hives together have 45,000 bees ready for the honey-flow. If the first hive had only just enough bees to allow the queen freedom, equalization would pull it down and lead to 22,500 bees being bred in each, but if the first hive was approaching its peak at the beginning of the month, there would be no difficulty in getting 30,000 eggs laid in each, *provided that the queen of the second hive is as good as that of the first.* If you give brood to a stock whose queen cannot keep up the brood-nest, you are going to be disappointed.

OLD QUEENS

There are queens which are not capable at any time of supporting a large brood-nest, but they are not very

common if the bees are of good strain and there has been no accident in the rearing of the queen. When they do crop up they are not easy to spot in spring, though you get hints from their general lack of vitality and their failure to respond to warm spells or to feeding of the stock. Much more common are queens which are too old. These are still harder to spot, because they may lay extremely well in April and show every sign of their native vitality, and then crack up completely when the full strain of laying comes on them. The best way to avoid this is to keep a record of all your queens so that you can be sure that no heavy work is expected of a queen after its second season. Part seasons count in the reckoning; a queen which is mated in September is, in effect, a year younger than one which was mated in May. If a queen fails at this time and you have no spare queen, the only thing you can do is to reduce the strength of her stock, if it will bear reduction, so that her brood will help another stock to full strength, and use the small stock which remains to rear another queen. It may be very useful in controlling swarming later on.

TECHNIQUE

Early equalization involves less work, but it is perhaps more risky. If you can have your stocks more or less equal at the end of April the job will have been done without moving nearly as many frames as you would have to move in May. The stocks will diverge a good deal later, but this divergence of strength will largely reflect the differing capacities of the queens, and can be disregarded except in extreme cases. But it is not a matter of great importance and, since the whole business should be approached with caution by those who are not used to it, there is no need to be in a hurry. In fact, many accidents are caused by being in too much of a hurry. Always bear

in mind that bees are not much use for the first week of their lives, so it takes a little while for a stock to absorb an extra frame of brood. It should not be expected to absorb another until it shows signs of expanding again of its own accord.

The first job is to get really weak stocks into some sort of shape. I have already suggested a technique for stocks which are so small that they have hardly any brood; a similar method will serve a little later to start the building up of stocks which have brood in only two frames or so. Swap the weaker of the two frames for a modest frame of brood, mostly sealed, with only the young bees on it. Ten days later it will probably be ready to receive a full frame of brood between the other two, and this frame can have all its bees with it. Many of them, of course, will go home, but enough will stay to keep up the warmth until more bees have emerged, and to augment the nursing staff. I have given a warning about the risk to the queen; try to prevent her being put against the stranger bees before the older ones have had a chance to go home. For the sake of the queens also, it is important to do this work when the bees are flying freely, both so that there shall be fewer field-bees on the frame taken from the strong stock, and so that those which are transferred shall go home quickly.

Some people like to leave the weakest stocks until last, and this is good policy if you have not much strength to play with. Then you can at least make sure of the stronger stocks; but if you are sure that you have enough strength for all, I think it pays to tackle the worst first, because you are getting practically no help from these queens until their brood-nests are built up a little.

You need to be careful in robbing the strong stocks that you do not take an undue proportion of their older brood and leave them short of nurses later. Try not to leave them

short of *any* age of brood, or you will cause unemployment in some age-group of the bees, and this is wasteful. It is worth noticing that a hive which has been reduced to five frames of brood is still a good deal stronger than one which has just been built up to five frames.

The greatest risk of all is that the queen of the strong stock will get transferred to the weaker stock and lost. The only sure protection against this is to make certain that she is not on the frame by actually seeing her on another. It is not enough that you do not see her on the frame which is taken. It is far easier to find queens at this time of year than it is later on; it is mainly a matter of training the eye to concentrate. Go through the hive slowly, looking in any holes, and especially in the bee-space between the bottom bar and the comb, and disregard all the interesting things you want to look at, such as the amount of brood or of food, the colour of the pollen, the spread of the brood-nest or the amount of drone-brood. Concentrate on the one thing only, and you will probably see her; if the hive has not been much disturbed, she will go on with her job.

CHANGING STANDS

There is another way of transferring strength from one hive to another, by exchanging the positions of two stocks on a warm day so that the stronger force of flying-bees enters the weaker stock. It is a rather rough-and-ready method, but it is often very useful, and it is quicker than the other; some beekeepers, in fact, do all their equalizing this way. Unless the weak stock is very weak, there is no risk to the queens, because they remain undisturbed with their own young bees in the brood-nest and the strange bees come in one by one, and not in a mass. They seem to accept the strange hive as their own immediately and without question. It is best not to use this method with

very weak stocks, even if a cage is used to protect the queen, because the stock does not receive enough nurse-bees to give a proper balance between the different age-groups.

MODEL CENTRE FOR VILLAGE INDUSTRIES, * T. KALLUPATTI. MADURAI DT. *
2 - JAN 1958

Chapter V

MAINTENANCE

I must turn aside for a little while to say something of the tools of the trade. First veils and other armour. I am not prepared to enter into the controversy whether it is or is not good beekeeping to wear a veil. It is neither here nor there. There are no sacred rites that you cannot witness without being well stung. Some experienced beekeepers wear a veil always, others only when they must. Personally I wear one as little as possible, because I hate hats and I find the heat and stagnant air inside a veil when it is worn for a long period are much more annoying than a few stings; my wife disagrees, and thinks I should be boiled all day rather than look like a prize-fighter in the evening. But I would not advise anyone to go without a veil who has not come to it gradually over several years of experience. It is better to wear veil, gloves, wellington boots and all the rest than to muddle things up because you are nervous. There are two kinds of veil; the one made of net is lighter and more comfortable, the one made of copper wire is easier to see through.

Gloves are more quickly discarded than the veil, because they are a great nuisance when they blunt the sensation of the fingers or make them fumble. They are also horribly hot in good beekeeping weather. Nevertheless, some people always wear them (as some gardeners do) to keep their hands free from propolis. Propolis, however, dissolves immediately in anything of the petrol family, and only needs a little rubbing with any of those soaps intended for really dirty hands. In most people the arms and hands are far less sensitive to stings than the face, and on the whole they are less likely to be stung if the bees are not aggravated by getting caught in a loose

sleeve. If there is anything loose, bees are bound to crawl into it; in fact, one of my objections to a veil is that there always seem to be as many bees inside trying to get out as outside trying to get in. So if you drop gloves, wear something to join the sleeve tightly to your wrist or roll up your sleeves. Any bee which is in two minds whether to sting or not will be provoked to sting if it finds your wrist-watch strap, and it is more likely to sting your wrist than the strap.

After you have got past the early stages of beekeeping, the wearing of too much armour on every occasion can easily blind you to the fact that you are keeping very vicious bees. Among my bees, if a stock makes me put a veil on when the rest are behaving normally, I make sure that that stock never gets bred from, and I may even change the queen, if there is one available. On several occasions I have been asked to help with some stocks and found them vicious beyond endurance, apparently without the owner knowing that they were anything out of the ordinary. If I mention their unusual spite, he says he understands that vicious bees get more honey than quiet ones, but now his bees have become too much for *him* to handle. There is something in the story of the vicious stocks being the best, but it does not by any means go the whole way; the best stocks are usually neither the dragons nor the doves. Excellence may be found right through the middle range of temper.

Again, even with bees of normal temper, if you never give them the slightest chance to sting you, you may get into bad habits of handling them when you should not, or handling them roughly. With normal bees the degree of the bees' resentment measures fairly closely the amount of disturbance you are making. So, when you are used to them, give them a sporting chance occasionally; you will appreciate the ventilation, and they will appreciate the

discretion which your vulnerability will impose on you.

SMOKER

Bees are frightened of smoke, and run from it. When a hive is opened, bees on the tops of the frames and others coming up between them take flight and sometimes attack, but if smoke is quickly puffed amongst them their reaction to the disturbance is changed, and they run down between the frames in fear. Followed by more smoke blown down between the frames, they look for open honey-cells and fill themselves, lest they should be driven out into the world with an empty stomach. If there are no open cells and they are properly frightened they will tear open sealed cells to get food. Once their minds are fixed on getting food, they more or less disregard the attacker, and when they are full of food they are amiable, like a newly-issued swarm which carries all the food it can. The amount of smoke which is needed varies with the bees and the circumstances, but if the bees keep coming up and trying to take wing as quickly as you drive them down, it means either that you are not using enough smoke or that you are in for trouble.

It is quite impossible to describe how much smoke should be used. Some nervous beekeepers can hardly be seen through the haze when they are manipulating, but I think the opposite fault is the commoner. You will not hurt bees with smoke provided it is not the hot smoke that comes with flame, but the more smoke you use the more you will disturb them, and the less you disturb them the better. Always use what smoke is needed to get the job done reasonably quickly and get the smoke right on to the bees at the moment of disturbance; once the colony has turned its mind fully to attack, it is much harder to switch it to fear. I suppose every beekeeper can remember

one or two undignified retreats and the awkward five minutes that follows while he wonders how he can creep up unnoticed to the open colony and get control again. Perhaps he never had control at all, because a hundred angry bees were on the wing before he got his smoker into action; perhaps he disregarded the plain warning the bees gave by refusing to be driven down, or perhaps he became engrossed in the job and did not notice the bees change their minds from fear to attack. Perhaps the smoker went out, or he kicked the hive or dropped a frame. I can remember in such a case creeping up and throwing a sack over the colony and bolting again, to return a few minutes later with a smoker going full tilt. The sack gave me the chance to get at the bees unobserved, and, by peeling it back slowly, I could lay a kind of creeping barrage across the top of the frames.

I suppose it happens to everybody once, but it is certainly not an ordinary part of beekeeping. Bees are easy to control in spring when the stocks are small, and often during the main honey-flow they can be manipulated freely without any smoke, and they will be too busy to take any notice at all, although I am not suggesting that it is worth exploring their amiability in this way. They are surly for several days whenever the honey-flow is cut off suddenly, and in late summer the great numbers of idle field-bees may be difficult to handle even when they have forgotten the palmy days of July. The idea that they resent having their honey taken from them comes, I think, from this being often done during the first week or two of August, when their temper is at its worst. They can be vile, too, when they are working on Heather, because the flow from this plant seems to go on and off like a tap.

There are other ways of frightening bees into submission. Some people like to use a cloth soaked in a carbolic solution, which they lay on top of the exposed frames, but

this is rather less adaptable than the smoker, and can hardly be used, for instance, for breaking up a cluster of bees when looking for the queen, nor is it so handy for giving the little doses which follow the first big dose and keep the bees in a good frame of mind. You can even use a hammer on the outside of the hive if you like, but if you try this remember that the first few blows infuriate; it is only the later ones that subdue. And it is not easy to keep up the treatment. Any really violent disturbance, as when bees are thrown from their frames, subdues: if you are ever called on to deal with some really impossible bees, you may earn a great reputation for courage by bumping them about and making them into a swarm before you try to do anything else.

But for general purposes use your judgement of the weather and the honey-flow (if you have any choice of time) and a smoker for control. The little cheap smokers whose nozzles come straight up from the firebox do the job all right, but the conventional fuel of corrugated cardboard is liable either to blaze or go out without warning. If you use slightly rotten sacking – which is far better fuel – it must be loose enough to keep some current of air going through the firebox while the smoker is idle, but even so they are liable to peter out if stood aside for long. All smokers must, of course, stand with the firebox vertical. The large (American type) smokers whose nozzles are at right angles to the firebox will hold a large roll of sacking, and keep alight without trouble for a long time. Their bigger output of smoke is sometimes a comfort. Most smokers are made of tinned steel, and they rust away very quickly if much used. A copper one costs little more, and lasts infinitely longer.

MAINTAINING THE HIVES

Some people still paint their hives, but it is certainly not

necessary to do so. Any of the wood preservatives do well enough. I use creosote, not only because it is the cheapest, but also because it seems to have some influence in controlling Acarine disease, a subject to which I shall come back later on. But any of the smelly preservatives, and especially creosote, are liable to cause robbing. It seems that the entrance guards recognize strangers at least partly by scent, and the smell of the creosote confuses them, especially as the robber bees, once they have got inside, begin to smell of creosote themselves and are still harder to distinguish. Worse still, once the robbing stock has made some headway, it begins to associate the smell of creosote with easy profits, and tries to get into every hive where it finds the same smell. I was once brought to realize that a newly-housed stock was being attacked when dozens of bees started to settle on an empty hive I was creosoting a hundred yards away.

There are two lines of defence against this robbery. Never use a newly creosoted hive (especially if it is creosoted inside as well as outside) until the smell has gone, and never put a weak stock in such a hive unless there is a good honey-flow to distract potential robbers. Hives left out of doors in warm weather with their roofs askew may be fit in five or six weeks; hives creosoted in the winter and kept indoors are not likely to be fit in April. The creosote does not go on soaking in; it has to be evaporated off the surface. Even in honey-flow weather there is a risk to weak stocks because the weather may change. Unless hives can be left idle for a very long period, it is best to leave creosote alone unless you have plenty of experience in detecting and dealing with robbery, or you may well lose a stock. I would not say so much about it were I not sure that I gain enough from its use to compensate for the risk and trouble.

SPRING CLEANING

In the early spring there is usually a good deal of refuse on the floor-board, and it is usual to get rid of this by changing the floor-board at about the beginning of March. This is easy in the case of National or American type hives, where the floor is loose. In W.B.C. hives the brood-chamber can be lifted out and put into another hive. The whole thing is done without disturbing the bees at all. It is not an operation of much importance, because the bees will do their own house-cleaning a little later on, provided that the floor slopes forward a little, but they cannot make a job of it where damp has cemented some rubbish on to the floor. Where hives have to be portable it is sometimes convenient to have the floors fixed semi-permanently to the hive bodies, and in that case it is not, I think, worth separating them. Myself, I do not bother with the floor-cleaning, but I reckon to change the hive completely every second year. A small strip of zinc nailed on to the hive allows for code marks to show when the hive was last treated.

NEW FRAMES

It is usual to replace frames whose combs are faulty in spring or early summer, because it is only during the period when the colony is expanding that it is likely to build good combs. The woodwork of the frame is usually sound and can be fitted with a new foundation. Wax foundation is often sent out from the factories with vertical (or near vertical) wires already embedded in it. You can, if you like, depend on these alone, fixing them in the top and bottom bars as the makers direct, but if you want to make sure there can be no bulging you can add horizontal wires as well. If the foundation is not wired you need three or four strong horizontal wires of tinned steel

or monel metal. Some people do not embed the wire into the wax, but put the wires alternately one side and the other of the foundation. This may lead to some badly shaped cells or even drone cells in places where the wire does not touch the wax, and the general opinion is in favour of embedding the wire. This can be done with a little heated wheel, the spur embedder, or more quickly and neatly with a low-voltage electric current passed directly through the wire so as to heat it. A car battery serves very well for this.

The wires should be tight enough to ping when plucked, but not tight enough to cut much into the wood where they pass through the frame or to distort the frame. Big frames, such as the M.D., need some vertical support if they are ever to be transported when heavy with honey. This is not so much to prevent them sagging, as to prevent them from breaking away below the top bar. A single V fixed to two staples on the underside of the top bar is enough; the point is to take hold of the top bar with something stronger than wax. For embedding, a piece of wood slightly smaller than the frame and just over half an inch thick is needed to support the foundation and keep it in such a position that the heated wire will sink into it. When the wire is heated electrically it often starts away from the wax as it expands, and something is needed to touch it back into place. When the wiring is horizontal only, the current can be sent through all four wires at once. Four or six volts (two or three cells of the accumulator) will probably be suitable; the thicker the wire, the higher the voltage which will be needed to heat it. But when the wiring runs both ways, only one wire can be heated at a time, because otherwise the current cuts across in the wires running the other way. In this case two volts (one cell) is all that can be used.

REPAIRING FRAMES

I have an idea that thousands of frames are scrapped every year without good reason. Since foundation is expensive and the job of fixing it takes a good deal of time, this is plain silly. I once came across a beekeeper who had been keeping bees a good many years who always scrapped his combs as soon as they became dark, and gave them 'nice clean ones'. This is the human fallacy at its worst. Though combs become stained a little as they get older, the dark colour of brood-combs comes mainly from the silken cocoons which the larvae spin when they pupate. The bees cannot remove them, and they add enormously to the strength of the comb; you will also notice that in natural conditions the bees tend to winter on the darkest combs in the lower centre of the brood-nest. It is true that the cocoons gradually reduce the size of the cell, but literally hundreds can be in the cell without making it too small for efficient brood-rearing. The gradual change from a hexagonal section to a circular section does not appear to matter, and the bees can, of course, increase the length. My own theory about it is that the cell is large enough so long as the queen can put her abdomen into it to lay the egg. If she cannot, and the comb is in the brood-nest, the bees will sometimes tear down parts of it, but it is difficult for them to rebuild it, because they have to get down to the original wax as a foundation for their new building.

Other reasons for rejecting frames are breakages, uneven surfaces, or excessive drone-comb. So long as the woodwork is sound, broken combs can sometimes be repaired. Electrically heated wires will sink right into the comb, though not, of course, through a mass of pupa-cases. If the whole comb has fallen right out of the frame, two or three pieces of fine wire can be pushed through it

just below the highest horizontal wire and twisted together above the top bar. They can be removed after the bees have secured the comb again, but it is just as well to leave them there. Uneven surfaces do not matter much so long as they are not bad enough to reduce the space available for brood, but bulges can leave the bees without headroom and make them cut away the comb. This is especially likely to happen when a bulgy comb is moved to a new place because in its old place the bulge probably agreed with a depression on the next comb. Bulges can sometimes be put right by simple pressure, but the comb must be warm, or it will snap.

With other kinds of damage the criterion should always be whether the brood-area of the comb is much reduced. There are times, especially in spring, when a colony has the nurses and the food for a larger brood-nest but cannot have it simply because the cluster is not big enough to heat it. At these times, especially, the combs which the bees can cover should be used to full advantage, and a faulty comb can cause direct loss to the future population. Excessive drone-comb has the same effect, but it is no use trying to keep the brood-nest in spring entirely free of drone-comb. The bees will make some drone-comb somewhere if you do not allow them any, and they may easily do so at the expense of a sound worker-comb. But large patches of drone-comb should be kept outside the actual brood-nest (where the queen will often hunt them out in her great haste to lay drone-eggs), and if there are too many they must be reduced, or the combs scrapped.

If faulty pieces or patches of drone-cells are carefully cut or torn out, the bees will often repair the comb efficiently. If it is put into the hive in May they will almost certainly fill the gap with more drone-cells, but if you can just manage to hit the moment when the colony is

expanding fast but is not yet prosperous enough to think of drones in a big way, you may get a perfect repair. In late summer (July or August), after drone-rearing is over, bees are reluctant to build much comb, but they will do a little repairing if circumstances allow you to put the faulty comb right in the middle of the brood-nest. The nest is shrinking at this time, of course, and gaps in combs outside it are likely to be filled with drone-comb for storage. In spring the combs must of necessity be put beside the brood-nest unless they are used to replace combs stolen from strong colonies – an excellent plan, except that these are the most likely colonies to build drone-comb.

FEEDERS

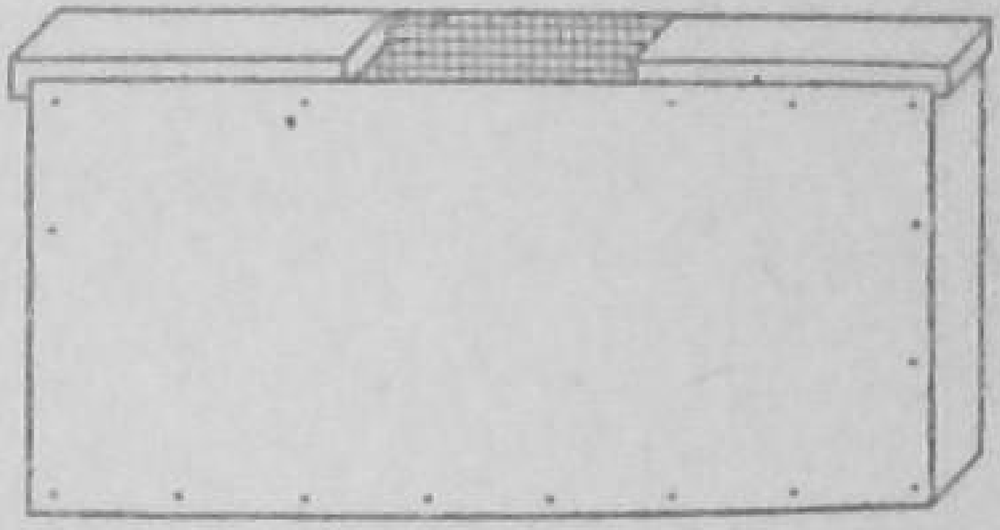
Many people are discouraged from beekeeping because they start, quite rightly, with a guide-book and a manufacturer's catalogue. Since the guide-book is thorough and the manufacturer only too anxious to please the customer, the would-be beekeeper discovers that he will have to put down £20 before he has got a single stock established, and that even then it is likely to die of disease or leave him for someone else who has got an even more comfortable hive and all that equipment which the modern bee just has to have. So the wretched man takes a week at Bournemouth or at Blackpool (according to his taste) instead, or even buys some really unprofitable pet, like a dog or a love-bird.

A certain amount of thoroughness is needed in a book of this sort, but I would really just as soon have written on 'How to Start Bees for Ten Shillings'. If you really want to keep bees but cannot afford the elaborate paraphernalia, your hardest job is to find the wild stock that you can take or the fool who will give you his honey-crop in the shape of a swarm; there is no difficulty in making up some sort of rough hive which will satisfy the bees, even if

it is somewhat tedious to work. While poking my nose into other people's hives recently, looking for brood diseases, I came across a lad with twenty stocks in every conceivable sort of hive. He only used little bits of foundation at the top of the frames, and he may have bought a few frames, but I do not suppose the whole outfit had cost him more than thirty shillings. Very cumbersome, of course, very tiresome to work, and he must have put in a great deal more time to make ugly stuff than the factory would have to make neat stuff, but that is in the nature of a hobby, and no doubt good equipment will follow when he has honey to sell.

The other sort of hobbyist, who, like the stamp collector, has to spend a lot of money on his hobby has ample scope in beekeeping. But even he will probably not get a single extra ounce of convenience from expensive feeders. The commercial beekeeper, who wants to feed perhaps 20 or 30 lb. to all the stocks in an apiary, and to do it without taking supers to the hives, has to have a special type of feeder. It is usually a tray which covers the whole top of the hive and is 2 or 3 inches deep. The bees come up through a slot or a pipe which brings them to the top of the syrup, and then walk down the outside of this pipe to reach the syrup as the level falls. A cage close to them prevents their falling into the syrup and drifting away. The pipe is often a long slot running the whole width of the feeder, because they do not feed readily if there is only a small hole. But for the man who keeps a few hives at home, the lever lid tin used for golden syrup, treacle, paint, &c., takes some beating. The holes in the lid must be small so that the syrup will not run out, and the lid sometimes needs a push to provide a full bee-space under it. Just as good is a 2-lb. jam-jar covered with a saucer or a large tin lid and turned upside down. This should be put very close to the hole in quilt or crown board until the

bees have learnt what it is. If a tin lid is used, make sure there is plenty of room for the bees to get down between the rim of the lid and the lip of the jar. Some people put a pin or a splinter between the jar and the saucer, but there is usually enough unevenness in the glass to let the bees suck out the syrup. For rapid feeding in the autumn as many as ten tins or jars can be fitted into a super. A super must, of course, be used with National or American hives, and the W.B.C. type should have the bee escapes in the roof blocked up, because inquisitive strangers sometimes manage to work them the wrong way round. A very use-



7. *Division board feeder. Wooden frame and hardboard sides, waterproofed by swilling with hot bitumastic.*

ful feeder is a hollow division board which does not drown the bees even if the internal diameter is as much as an inch. It holds 5–8 lb. of syrup.

HIVE RECORD

For one or two hives memory may serve, but beyond that a record is essential, if only to keep track of the queens and make sure that they are not too old. You can use a book or some sort of card for each individual hive. A book would not suit me; I should lose it or drop it in a puddle, and it is a basket holding too many eggs to be risked that way. Cards under the hive roof are liable to perish or become illegible during the winter. I gave them up long ago in favour of thin slips of painted wood which can be given another coat and used for many years. One side of an old

honey section is very good, because of the great smoothness of the wood. If they are loose under the roof they are a nuisance in manipulating; if they are fixed on the underside of the roof, the roof has to be lifted to get at them, and they are likely to go astray if the roofs get mixed up while transporting the hives. My present plan is to keep them under the roof in winter, but during the active season they live behind a clip on the back of the hive, where they can be got at without waste of effort. The clip is half one side of a honey-section, and it is fixed at the bottom with one screw, to prevent it from gradually pulling off, and one tack, to stop it turning sideways. Metal clips may stain the card. Beware of glossy paint, for a pencil makes no impression on it. Later on I will give some examples of the kind of information which is on these cards.

Chapter VI

THE SWARMING SEASON

There is a kind of false swarm, called a hunger swarm, which is not a division of the colony, but a desertion. All the bees go except those few that are too young to fly, and even these crawl out of the hive and try to go. It happens most often when a small stock has very little food and the honey season has come to an end, during the first two weeks of August; it can also happen when a stock is bankrupt in spring. Little colonies which desert usually join themselves to another, but stronger ones may behave as a swarm and find themselves a new home, where they quickly perish. The joining together of small colonies makes sense, but the hopeless drifting of the others is odd indeed. It may be an instinct coming down from a time when honey-bees migrated from one district to another, being prompted to move to a better place by shortage of food, as some species of bees do today. Newly-hived swarms, too, will often desert soon after they have been hived, either because they do not like the smell or the position of the hive, or perhaps simply because their scouts had found a good home before they were hived and they prefer their own choice.

Desertions apart, the earliest true swarm I have ever heard of in Britain was on 1 April, and the latest early in September, but I think it would be fair to say that, unless the season is a very early one, 95 per cent of all swarms come out between 10 May and 15 July. The peak of the swarming impulse is reached at different times in different seasons, and it is greatly influenced by the weather; perhaps it comes most often in early June.

CAUSE OF SWARMING

There are those who say that swarming is a trouble brought on us by keeping bees in the way we do, meddling with them and feeding them on sugar and generally treating them in an unnatural way, but since swarming is the only means bees have of propagating their kind, this is the same thing as saying that wild animals will breed if you treat them unnaturally, but not if you leave them alone. It also overlooks the readiness of wild bees to swarm. It is no use looking on swarming as a disease of civilization, to be cured by a reversion to a simpler life, nor indeed as a disease of any sort: it is as natural for bees to swarm as it is for a cow to suckle her calf, and, since swarming does not always suit us, it is up to us to frustrate the bees' instinct as harmlessly (and as profitably) as we frustrate the cow's instinct.

It seems that several factors act together to turn the mind of a colony along the track that leads to swarming. One of them – the season of the year – we can do nothing about; the others we can control a good deal. When the mind is turned towards swarming, we, or the weather, may succeed in turning it away again, especially in the early stages; for it is undoubtedly true that the nearer bees get to swarming the more determined they are to swarm. If we fail to turn it away, we can in the last resort fool them into thinking that they have achieved their object. We have three lines of attack: to mitigate the predisposing factors, to turn the bees aside from their intention, and to fool them into thinking they have achieved their object.

WHY MUST WE CHECK SWARMING?

Of all the questions I am asked about bees, far and away the commonest is 'How do you stop them swarming?' I

have learnt to be cautious about this one, and to answer that everybody has his own ideas, but that if I may have a little time I will try to explain what I do. 'Oh dear!' I hear. 'I thought it might be something simple. Can't you do it by cutting out the queen-cells? There's a man in our village who goes round doing that.' Swarm control is the very lynch-pin of commercial beekeeping. Would you expect a tailor to give you a simple rule for cutting out a suit? But at least we know that most beekeepers would like to be able to control swarming.

To the commercial man control is essential, because his bees are scattered about, and he is most unlikely to be there when a swarm comes off, nor can he possibly employ someone to watch for swarms. To the amateur it is not essential, but it saves a great deal of nuisance, and if it is well done it will certainly increase his crop, especially in lean years. Any conversation among beekeepers in summer proves that bees invariably swarm at the wrong time; the parson's come out on Sunday morning, the office worker's on the only day when he is kept late; if you spend a day in bed or go away for the week-end, the bees gleefully take their opportunity, and the next thing you know is that a friend a mile away is telling you with great joy that a really strong swarm has come into one of his hives. Pride forbids that you should ask for it back when you find that it was yours; in any case, you cannot prove it. If the swarm does come off at a reasonable time you still have the trouble of catching it and hiving it, and, even if you have all the equipment handy, that may still take a great deal longer than it would have taken you to prevent it.

Apart from the nuisance, there is the loss of honey which usually follows free swarming. Nature does not plan for the largest possible storage in any one hive; she prefers two stocks each with 40 lb. rather than one stock with

120 lb. If that is what you want – two good stocks in place of one – swarming is a natural and easy way of getting it. If July is warm you may get surplus honey, and if the original stock is very strong and the swarm very early, you may actually get more surplus than you would have got from the single stock.

But why does the one stock which might have got 120 lb. divide into two stocks which get 40 lb. each? Why not 60 lb.? (These are gross weights, not the weights of the surplus.)

Suppose that a stock with 60,000 bees swarms on 10 June, and that a week later, after some deaths and births, there are 30,000 bees in each stock, the swarm and the parent. Can we not assume that the total number of field-bees of the two stocks put together will be the same from 10 June to 25 July, as it would have been if there had been no swarm, and that consequently the gross honey take will be the same? We cannot, because there will be two full-sized brood-nests to maintain. If we make a further assumption that 20,000 bees, nurses, and other indoor workers are needed to maintain a brood-nest as large as the bees like to make it in July, the single stock would have 40,000 field-bees, but the divisions would have only 10,000 each, so the gross yield of the single stock would be double that of the other two combined.

In practice it would not work out as neatly as that, because the bees would not adapt themselves so readily to the jobs which are not the proper jobs of their age; but they adapt themselves enough roughly to give this result. To have 40,000 field-bees, the single colony would have to put its surplus young bees to work out of doors, and the swarm, like all swarms, would have to keep its nurses nursing so long as they could make a drop of food for the youngest larvae. Sixty thousand bees, by the way, is probably about as many bees as could be found in

any hive that had not been artificially supplied with brood.

But now put the whole thing back a month. The swarm comes off on 10 May. By 1 June the swarm begins to have brood emerging, and by 12 June or so the parent does the same. By early July both have a full force of flying bees, and if July is a good month there is no reason why both stocks should not gather as much honey in July as the single stock would have done. One well-known beekeeper (Tickner Edwardes) was so impressed by the gathering power of early swarms that he did all he could to persuade his stocks to swarm early, and then made the swarm still stronger by giving it the stand (and so the flying-bees) of the parent stock. He then depended on these big swarms for his surplus. I do not know whether he ever got the bulk of his stocks to swarm in the first half of May: I know I should not like to try to make a regular system out of it myself. Even early swarms will not do the trick unless the stocks are very strong; a cold winter may leave the stocks too weak, and a cold spring will not let the bees build quickly to swarming pitch. There is the further risk that the honey-flow may be mainly in June, and not in July; in this case even an early swarm will be too late.

FACTORS THAT DISPOSE THE BEES TO SWARM

A stock with a good queen does not usually prepare to swarm until it is in a prosperous condition – I do not mean prosperous in stores, but in population. There must be great surplus of bees over and above those that are required to maintain the brood-nest. A very small stock is not likely to swarm, but a medium stock whose brood-nest has not been expanding very fast can easily be in a state of population prosperity, while a stock with a large brood-nest built up fast may have no surplus bees at all and be hardly able to maintain the brood it has. There is

a partial exception to this rule in supersedure swarming. If the queen is old or faulty, the supersedure impulse may change to the swarming impulse at any stage, and even at the very last moment under the influence of fine weather, and there may be a very small swarm from a colony that is not really fit to swarm at all.

This population prosperity is not a cause of swarming; it is just a condition which has to exist before swarming is possible. If it caused swarming you would expect many swarms in August when all the colonies are in this condition. Of the actual factors which dispose the bees to swarm, I would put first a queen who has reached middle age, and second an inborn tendency to swarm in that particular strain.

There is no clear line of distinction between swarming and supersedure swarming. The queen may be good and laying well, yet the nearer she is to the end of her useful life, the more likely is her stock to swarm. It is commonly said – and it is very true – that a colony hardly ever swarms if it has a queen reared during the current season. A colony of non-swarming strain with a one-year-old queen will probably not swarm; the same colony with the same queen in the following year probably will swarm. I do not pretend to know whether the bees in some way know the age of the queen, or whether something in her own behaviour starts them on the swarming track; perhaps she is not so flexible in her egg-laying and cannot so quickly take up the slack when a big emergence of brood or a sudden warm spell allows a quick expansion of the brood-nest, or perhaps she actually takes rest periods when her laying is below normal. I know I have often, when inspecting a stock with a two-year-old queen towards the end of the building-up period, written on the record card 'Queen failing', and then come back a few days later to find her laying as hard as ever. In theory,

then, you can control swarming by replacing all your queens with newly mated queens just before the swarming season: in practice you cannot, because you cannot rely on getting them mated so early in the season, nor (unless you have made preparations the year before) can you spare the strength of bees for all the queen-rearing colonies you would need. Nevertheless many beekeepers re-queen in June, and so do away with the risk of later swarms.

NON-SWARMING STRAINS

I have never seen a strain of bees which would never, in any circumstances, swarm, but anybody who has kept a few stocks for several years will know that some of them swarm regularly and others only rarely, and that these characteristics tend to stick to the colonies unless different queens are deliberately introduced. The swarming propensity is not associated with any particular colour. Certain races of brown bee (in particular the Dutch) have a great reputation for swarming, while the Italians are said to be less determined; but many yellow strains are inveterate swarmers. We are told that they are degenerate, while black bees which swarm too much are just typical of their race. In any case, I think it is mainly determined by the history of the strain: the Dutch are perhaps nearer to skep beekeeping, with its tendency to favour swarms, while the Italians have been fashionable among modern beekeepers all over the world for two generations and have produced some good non-swarming strains. But these strains crop up in any type of bee, and can be maintained by a careful beekeeper. My own favourite for many years was a strain so dark that it certainly could not be distinguished from a Dutch bee by colour, but its swarming habits were excellent. Certainly colour is the last thing which should have any influence on you when you are choosing good strains among your bees.

Beekeepers have noticed for a long time that two different strains can live side by side for years without mixing much, and now investigation has shown that the reason for this is that bees usually inbreed. The queen usually mates with her own mother's son, but he, since her father is not his father, is more her uncle than her brother. Inbreeding is the rule, cross-breeding the exception, and this would be even more true where a wild stock is away on its own, at some distance from other stocks, so it cannot be harmful. I mention this peculiarity at this stage not only because it explains the constancy of strains, but also because the knowledge of it gives the small beekeeper at least a rough-and-ready means of perpetuating selected strains and increasing their numbers. When a queen is introduced into a stock, the whole stock (after the death of the existing bees) becomes hers, and hers alone; there is no mixture of the blood. When a stock supersedes its queen or is made to rear another, the new queen will probably (but not certainly) be of the same strain as her mother. Therefore, if you have two stocks, A and B, and A is of good strain and B is bad, you want to find some opportunity of introducing the queen of A into B and rearing a new queen in A. You will be unlucky if the new queen does not produce bees of pure A strain. But if you set up a little colony and in it rear a new A queen, she (probably having hardly any drones in her own stock) may just as well meet a drone from B as from A, and her bees may be A×B. If you want several A queens and have the little stocks to rear them late in the season, you can rely on B killing off all its drones by the middle of August. If A is made queenless at the beginning of August and you can be sure that the little stocks are either droneless or have only A drones, then all the young queens must mate with A drones. The colony A will keep its drones as long as it has no fertile queen.

I apologize for this digression. It was prompted by the common notion that the smaller beekeeper can do nothing in the way of selective breeding because he cannot choose what drones he will use. It certainly is not easy for him (or for any beekeeper) to breed bees as cattle are bred, but if the rough-and-ready method I have suggested can help in developing a good strain, the digression is worth while. It is hard to control swarming if you have *no* control of breeding.

I have often noticed that non-swarming strains are reluctant to build queen-cells and they usually build fewer than other strains. Even when you take the queen away, they may wait several days, and then manage only a couple of small cells at a time of year when a swarming strain would have started a dozen. This means that when you want queen-cells from them it is usually better to get the cells built in another stock to which the selected brood has been transferred. There is no need at all to carry the thing too far and to try to produce bees that will never swarm. Excessive concentration on one point in breeding always leads to deterioration somewhere else. I make the simple rule that I do not breed from a queen whose bees have offered to swarm in the season when she was one year old, and I like her to show that she is capable of building up a good stock in her second season. She is finally judged for the productivity of her bees, but she has to pass the swarming test first.

MINOR CAUSES OF SWARMING

Once you have got queens of a productive strain, not too ready to swarm and not too old for their job, you are a successful beekeeper. At least, this is more than half the job in beekeeping generally, not only in swarm control. But there are a number of minor factors which, so long as the bees are not crowded or badly ventilated, are really

just irritations which serve to pull the trigger when the gun is already loaded by the nature of the strain and the condition of the queen. They have their importance all the same, because although one stock may be predestined to swarm and another predestined not to, a third may not be clearly bent one way or the other, and these other factors will decide its course.

Some years have many more swarms than others, according to the weather. Although swarms usually come out on a fine day, it is not fine weather that causes them. The swarm which comes off today was decided on nearly a fortnight ago, and if the weather played any part in the decision it was probably erratic weather. A colony which builds steadily up to its maximum and then, before it has accumulated a large surplus population, immediately finds a steady honey-flow is unlikely to swarm unless it very badly needs to; but anything which checks the build-up and, by keeping down the size of the brood-nest, puts some of the bees out of work will make the colony think of swarming if it is inclined that way. A chilly spell of weather can cause this check, and so can warm wet weather if the food reserve is small. Feeding will keep the bees going in wet weather, and will help if the weather is cold. If the check comes when the brood-nest is fully built and the honey-flow should be beginning (drought, as well as wet or cold, can cause this), there may be a great spate of swarming because all the stocks are ready to swarm at once and all those which can be provoked to swarm will do so. In this case the beekeeper will get no peace until the honey-flow starts.

Another provocation is shortage of room, whether real or imaginary. No beekeeper who pays any attention to his bees is likely to forget to put on the first super, or the upper brood-chamber if two are used, but the stock, especially if it is not very strong, may be pig-headed and

refuse to recognize that it is there. It may delay for a day or two in making the jump from one hive-body to the other, and during this short time it may decide to swarm, and still stick to the idea when it discovers it has plenty of space after all. Unless the beekeeper has artificially divided the brood-nest by brood-spreading or some other manipulation, it is not likely to make this mistake in an M.D. hive. Some poor strains of bee shut themselves in quite unnecessarily with a tight ring of sealed honey and pollen, and will not break through it to expand the nest. You can stimulate these a little by scraping the cappings off some of their honey with your pocket-knife, in the hope that they will then risk keeping it a little farther away from the living-room; but in the end you must get rid of the strain. The only useful bees are the big business men who do not mind taking a large risk for the chance of large profits. The small-scale miser gets nowhere. He may have some small value for survival in bad years, but in modern beekeeping the big business men can be helped when they get into trouble. The beekeeper will look after their survival if they will go all out for the profits.

Overcrowding, whether real or false, can be mitigated by opening up the entrances as soon as the stocks get strong and by allowing plenty of room between the bottom of the frames and the floorboard. The bee-space rule does not apply here, and an inch or more can be left open without much risk of getting any comb built in it. This allows the cluster to hang down when the bees are all at home and reduces the crowding in the hive. Some even go so far as to put empty supers or supers containing only foundation under the brood-chamber during the swarming season. Overheating, caused by the hive standing full in the sun in a place where there is little movement of air, can have the same effect as overcrowding, for the hotter it is the more the cluster must spread. Fully sheltered sites

which may be excellent in winter may be too hot in summer.

CONTROL BY MANIPULATION

So far I have suggested a few ways of making your bees less inclined to swarm, all of which fall short of actual manipulation of the brood-nest. But before I go on there is one warning. It is not wise to go in for swarm control unless you are going right through with it. If your control merely makes the swarms come off late instead of early, you have lost, not gained, for early swarms are the more useful.

Quite an infinite number of systems have been devised for the manipulative part of swarm control; in fact nearly everybody has his own ideas and holds them strongly. All I can do is to divide the systems into groups and say something about each group, and then say something of what I do myself. Running through all the systems are two main ideas: to delay the swarm until the main honey-flow makes swarming unlikely, or to satisfy the swarming instinct by persuading a stock that it is a swarm or a swarmed stock.

Since some of the systems involve the removal of the queen, it is as well to know for your own district the date which I will call the 'critical date'. It takes roughly six weeks for an egg to become a field-bee. The critical date is the last day on which an egg must be laid if it is to be of real use for gathering this year's honey-flow. The assumption is that the removal of the queen after this date will make no difference to the number of bees flying until it is too late to matter. In Southern White Clover districts this date is often given as 1 June, but there are several reasons why I think that is much too early. I have previously suggested 1 June as the date to be aimed at for the peak of brood-rearing, but that is a different matter.

Six weeks from 1 June is 12 July, which is getting near

the end of the flow in a hot, dry year, but in some seasons the whole of the surplus is gathered after that date. In 1948 most of the honey was gathered during the last five days of July. So, on this account, I would put the date forward to 10 June. But there is something else. After being queenless for a time the stock will be re-queened and a brood-nest will develop. A supply of nurses from the old queen's brood will be available four weeks after her removal. Five weeks after her removal nurses of normal age will have disappeared and their work will have to be done by older bees, so the removal of the queen begins to shrink the field force between four and five weeks later. To make yourself safe, then, put the date at 15 June for Southern districts, and perhaps as late as 1 July in cool, late White Clover districts.

ARTIFICIAL SWARMING

You can save all the trouble and risk of natural swarming by taking the swarm off artificially. It is as well to wait, if possible, until the first queen-cell is sealed, because after the division it may not be so well looked after. Remove all the brood-frames and one or two of the best food-frames to a new hive, and leave the queen and about half the bees in the old hive. By the time the flying-bees have gone home there should be about one-third of the bees with the brood and two-thirds with the queen. Fill up both hives with frames of comb or foundation, and be careful to keep the brood-nest in its original shape, because it will be short of bees to keep it warm. If you want increase, that is all there is to it; if you do not or have no spare hive, use a temporary hive for the brood – a brood-chamber covered with a folded sack, some waterproof paper and a couple of bricks will do well; – put it beside the old hive, but facing the opposite way. During the next twenty days the young queen will emerge and get mated. When she is

laying, kill the old queen in the other hive (she should have made a good brood-nest by now), and put the temporary hive on top of the original hive. Queen-excluder and supers should be above both brood-chambers, but the excluder can be brought down between the brood-chambers when the queen has taken possession of the lower one.

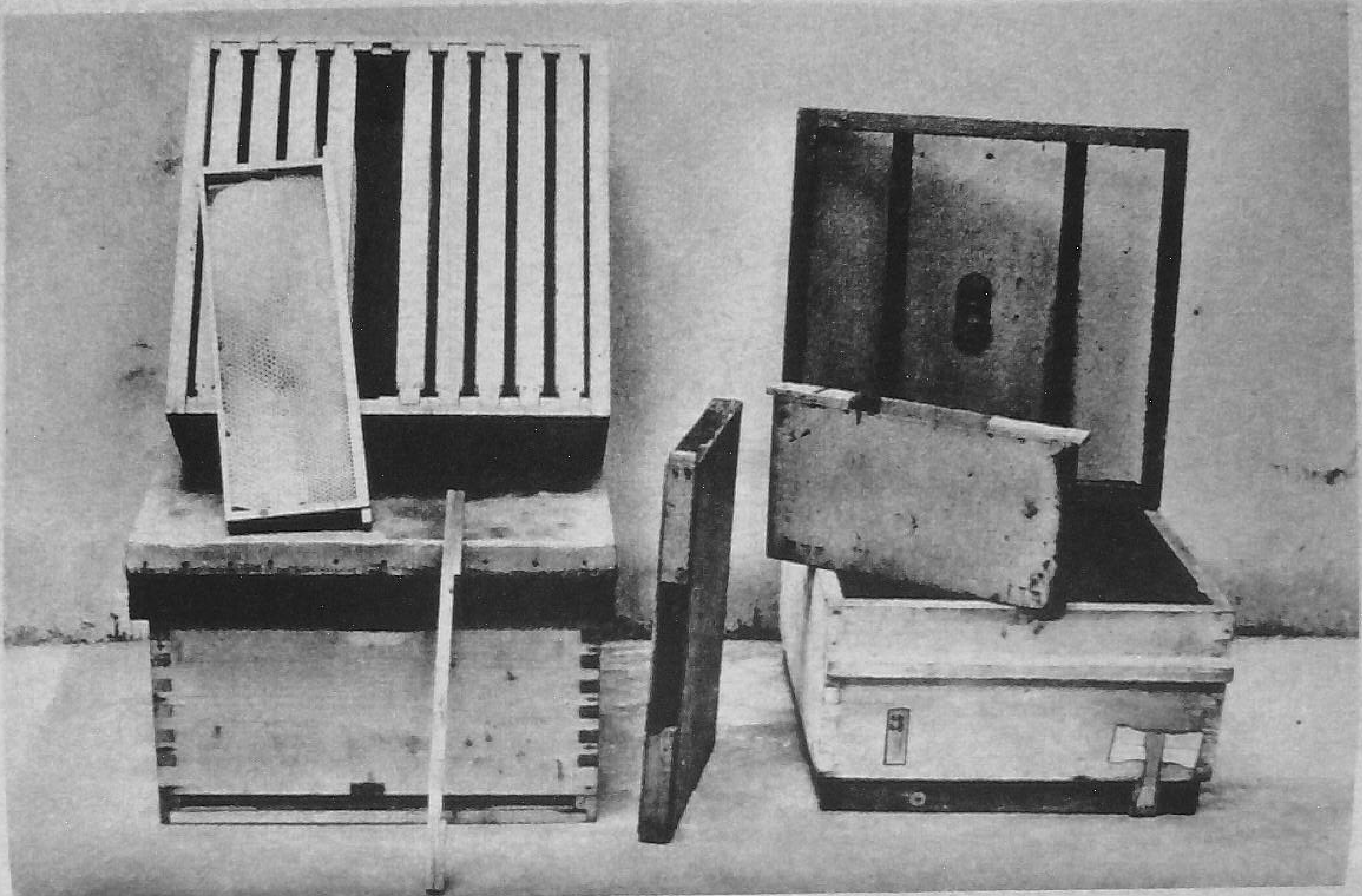
This is in many ways a very good system. It keeps the old queen hard at work and leaves the stock with a young queen, and it lets the beekeeper dictate the time of swarming. Its chief disadvantage is that it makes you breed your young queen from a swarming strain unless you have got a better queen in a nucleus that you can introduce to the queenless division. A second swarm from the division is not very likely because of the very small number of field bees in this stock, but it is best to make sure by reducing the queen-cells to one only and seeing to it that no more are built. Regular inspection of the brood is necessary in the early part of the season to discover the queen-cells, but no further inspection is needed after the division except once to make sure that the young queen is laying.

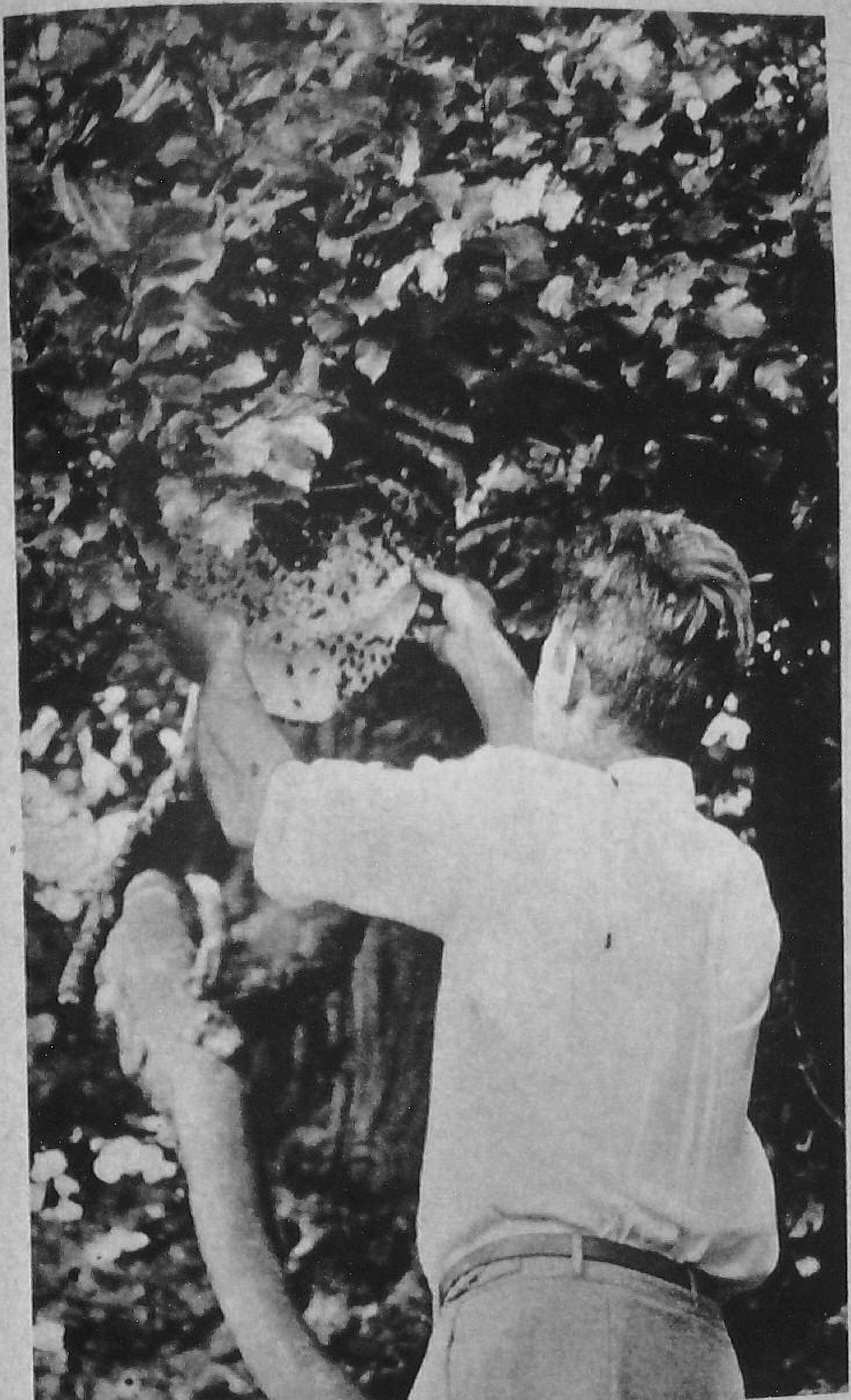
I believe that this simple method would be used far more by those who have just one or two hives if it were not for the difficulty of finding the queen. Only practice and concentration will make it easy to find her, but when things are desperate the following trick may serve.

Move the hive aside and put the new hive in its place. Fill it up with empty frames. Shake or bump all the bees from the original brood-frames in front of the new hive and make sure that the queen is not on the walls of the old hive. She must now be in the new hive. Put an excluder over the new hive and put the old hive with the brood above. Nurse-bees will quickly come up through the excluder to attend to the brood. When enough bees

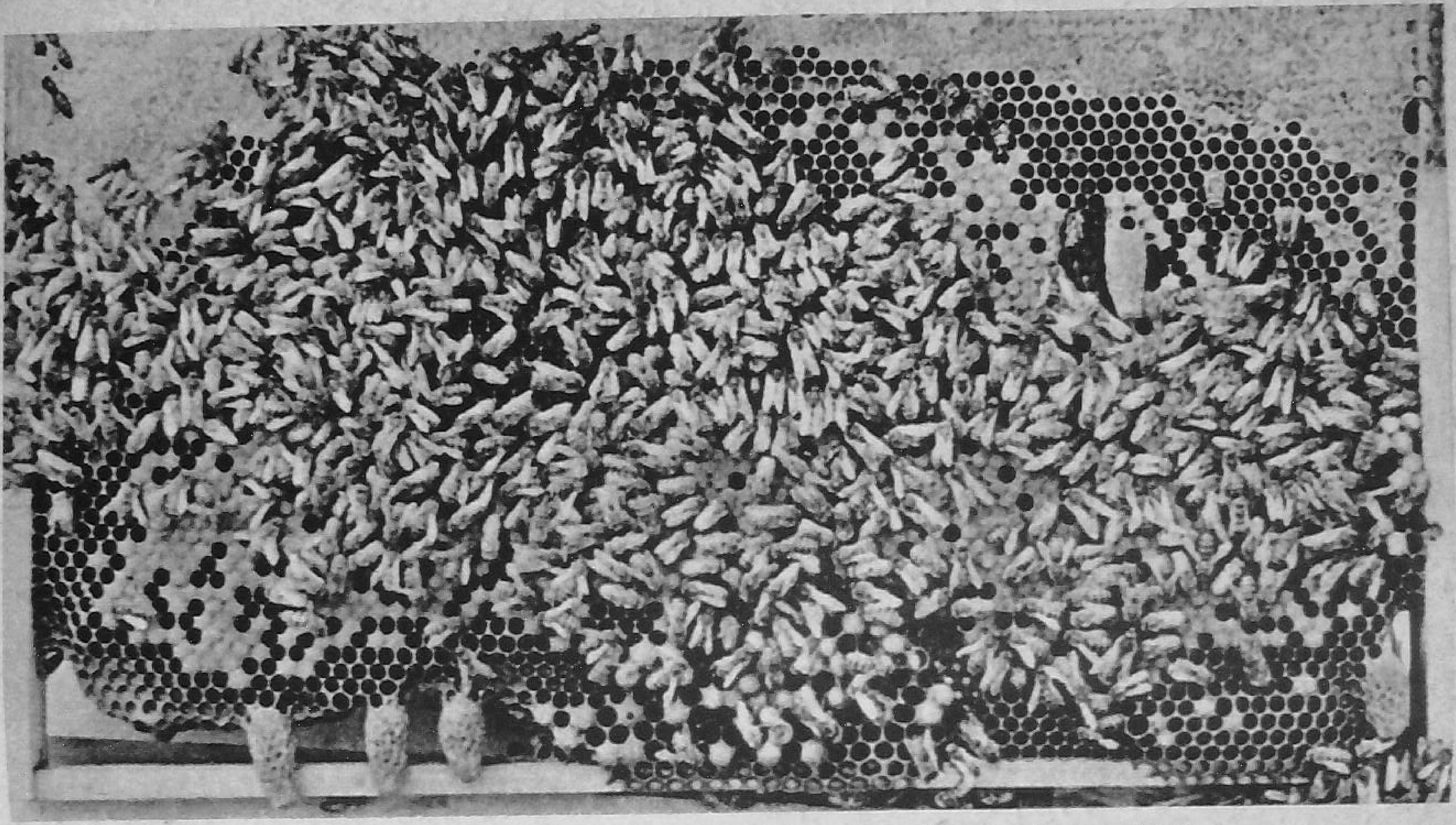
1. A large swarm which had lived for 28 days under the branch of an elm tree. *Photo by R. Bennett*

2. *Left*: Portable 12 frame M.D. hive and super with wooden spacing rack. *Right*: 11 frame British hive showing record card and zinc maintenance record at the back, division board feeders and screen for closing hive for transit.

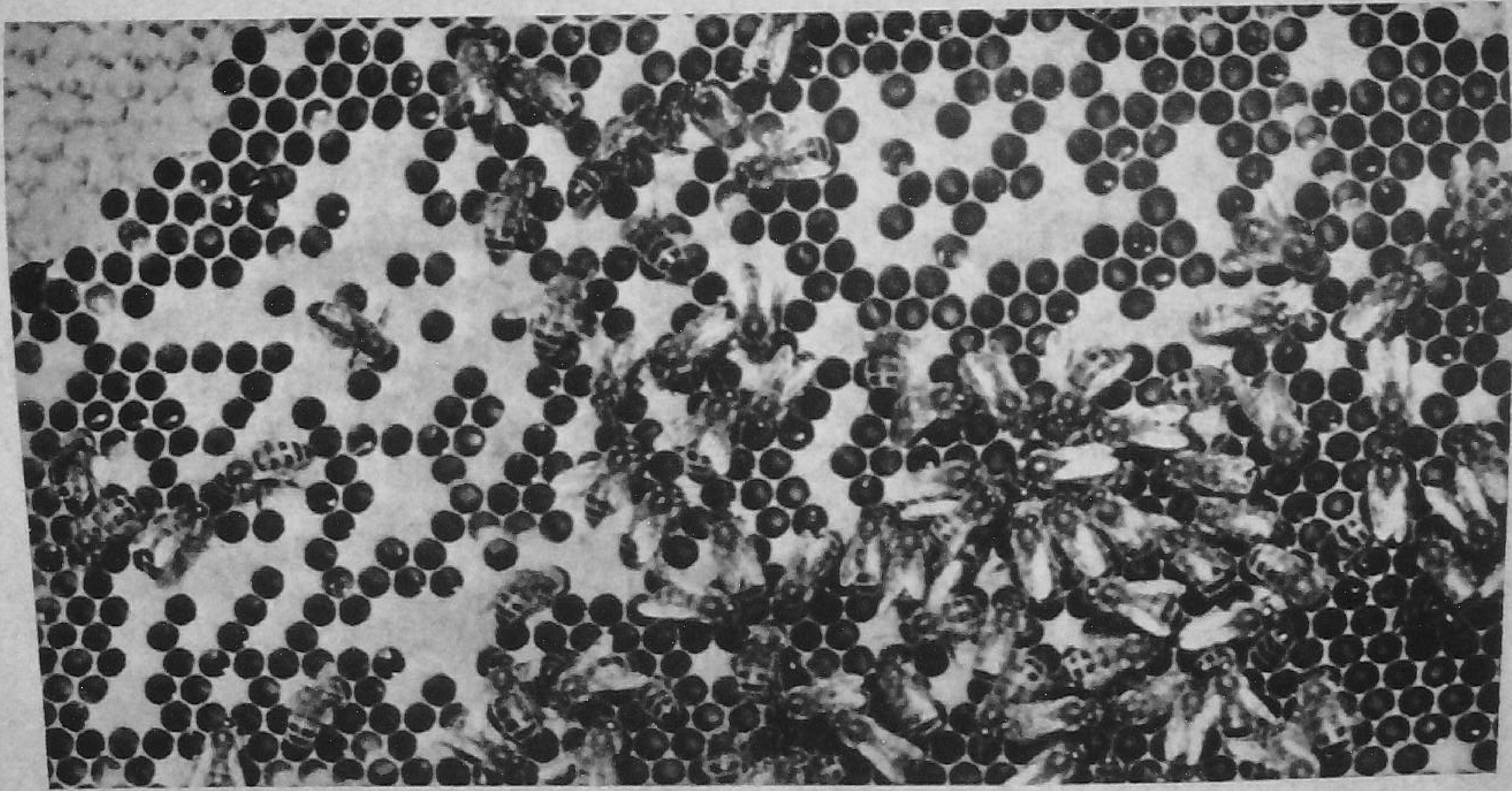




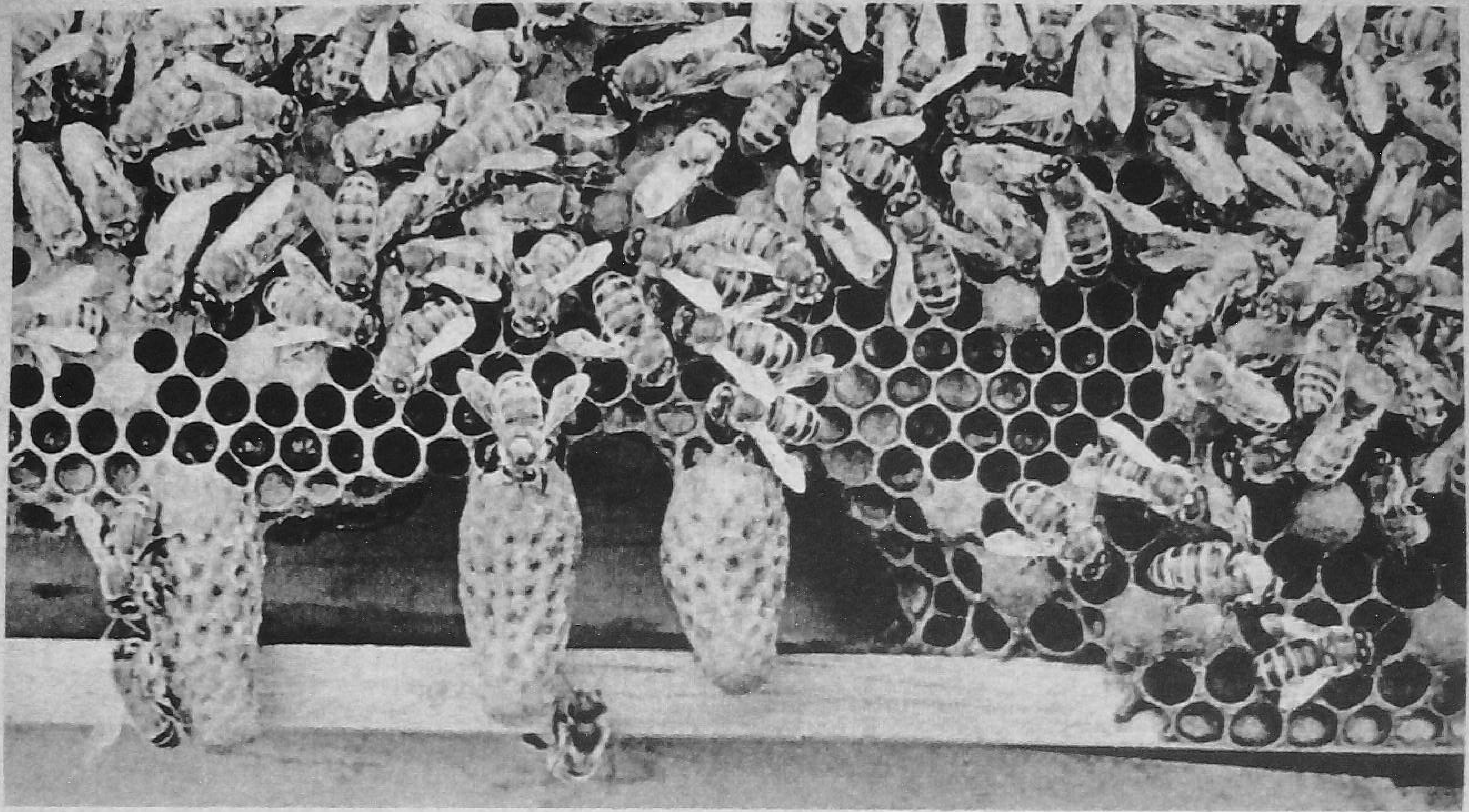
3. The author removing the combs of the same swarm. The emerged brood in the centre shows how long the stock had been living there.
Photo by R. Bennett



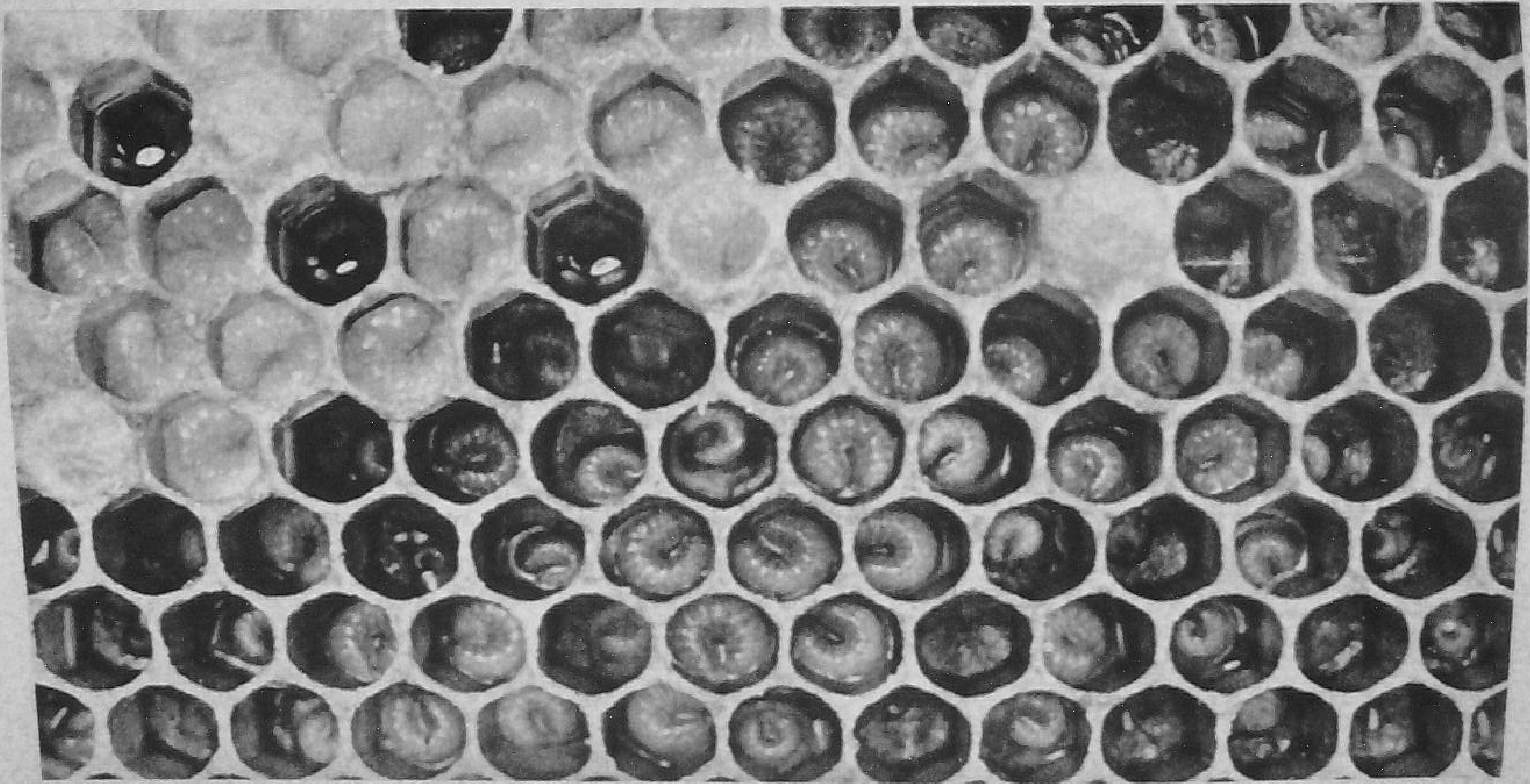
4. A brood comb with five queen cells. Drone brood at the bottom. *Photo by H. Teal*



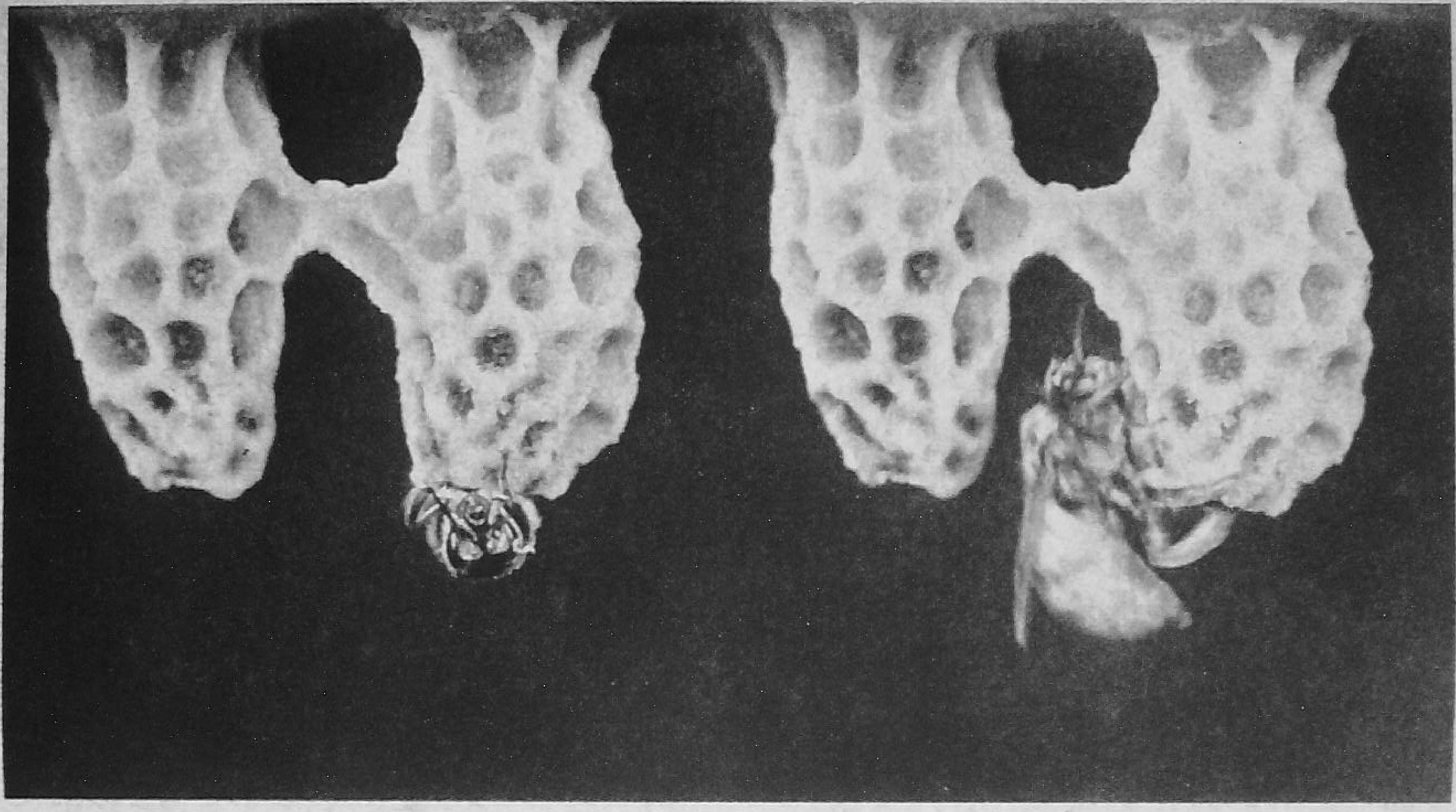
5. Sealed and unsealed honey, sealed brood and workers surrounding queen. *Photo by H. Teal*



6. Workers, drones, sealed queen cells, and a few sealed drone cells in the bottom right-hand corner. *Photo* by *H. Teal*



7. Normal brood in all stages. *Photo by H. Teal*



8. Queen emerging from her cell. Notice her pale colour and soft, downy coat. *Photo by H. Teal*

have come up, remove the old hive with the brood in it, and give back to the artificial swarm one or two frames containing food, but without bees. The frame which contains the selected queen-cell should not be shaken or bumped. Brush most of the bees off with a tuft of grass or smoke them off this frame. Incidentally, the best way of shaking bees is to hold the frame by both lugs and swing it fast towards the ground. Check it suddenly, and most of the bees will come off. To get the last bees off hold one lug in the left hand and bump the other end of the top bar violently with the side of your closed right fist.

STRETCHING THE COLONY

There is a whole series of manipulations designed to delay swarming by spreading out the nest and making the bees feel they have not yet reached the moment when they should start their cells. One of the simplest is the shifting about of frames (without disturbing the brood-nest) so as to keep the bees always in touch with frames of undrawn foundation. The idea is to avoid unemployment or any threat of self-satisfaction, but unfortunately the bees are inclined to desert this relief work when the weather is unpleasant, and start their queen-cells instead. More drastic but more effective are the various systems of brood-spreading, either by inserting empty frames into the existing brood-nest or by spreading the brood into two brood-chambers. This last is the well-known Demaree system.

The idea is something like the artificial swarm, but since no new queen is reared, there is risk of a later swarm. The queen, with only one or two frames of brood, is left in the lower chamber, and the rest of the brood is in the upper chamber above an excluder. After a week or so more frames of the new brood below can be swapped for frames from which bees have emerged above, so that

the brood-nest is kept always incomplete. This system can be very effective, but all brood-spreading brings risk if the weather turns cold after the manipulation. The queen may go on laying only in the one or two frames that have been left to her, and in extreme cases the bees may even desert these frames altogether and leave the queen stranded below the excluder. The manipulation is reasonably safe only when there is already a considerable surplus of bees – about the time when they might begin to think of swarming. Very good judgement is needed, or it may be done too early, with great loss, or too late, when queen-cells have already been built. It only applies, of course, to British or other small hives where a double brood-chamber is tolerable.

KILLING QUEEN-CELLS

The cutting out or killing of queen-cells is not a system in itself, but it can be a useful delaying tactic, especially at times when the swarming impulse is not at its strongest, before the middle of May or in July. It is much more effective if the cells are destroyed in the early stages when they contain eggs or very young larvae, but it is essential to destroy every cell, and they are not likely to be all found unless some of the bees are shaken off the frames, so it is a rather slow operation, and causes a good deal of disturbance, especially when a honey-flow is going on, because then great quantities of nectar fall from the frames when they are shaken. After it has been done the bees usually start more cells at once, but if circumstances have changed they may give up swarming for the moment. If there are sealed cells, and especially if the queen has begun to reduce her egg-laying in readiness for the flight, the bees may swarm without any cells. They may also do this after the removal of several batches of unsealed cells. When supersedure swarms threaten in July,

the killing of even sealed cells will delay the issue until the swarming season is over, and make possible a normal supersedure in August. But in the main swarming season it is best to use it only to gain a little time. Sometimes, after only one cell-killing, honey will start to come in in plenty and turn the bees' attention away from swarming. When this happens the operation has been really useful.

REMOVAL OF QUEEN

The removal of all the brood, whether in artificial swarming or otherwise, leaves the stock in the condition of a swarm, and it accepts that condition; the removal of the queen leaves it in the condition of a swarmed stock. The swarm does not try to swarm again (at least, not for a long time), but the swarmed stock is likely to throw a swarm as soon as a queen can fly. Consequently a stock which has been put in the condition of a swarmed stock, but which has never really swarmed at all and is crowded with bees, is going to make every possible effort to swarm. If one of the original cells is left, more cells will promptly be built, and a swarm will go off with the virgin as soon as she can fly. So it is usual to depend on outside sources for the new queen, and this gives you a chance of introducing a queen of different strain. The cells are all destroyed when the queen is removed, and again seven days later, when there are no longer any larvae young enough to be made into queens. A queen-cell from another stock can be given at this stage, or, better still, a fertile queen from a nucleus can be introduced about the tenth or eleventh day, after all the brood has been sealed over.

Provided the queen given to the stock is a young one this is a highly efficient method of preventing swarms for the rest of the season, but it is rather tricky, and there are likely to be accidents occasionally even when an

experienced man does the job. Since it stops brood-rearing, it cannot be done before the critical date without great loss of honey. Some beekeepers who like to re-queen all their stocks every year do this to all their stocks in June, and they claim that the surplus of honey is increased by the rearing of less brood during the honey-flow; but the average beekeeper will not have enough young queens to re-queen all his stocks in this way. I have heard it said that this scheme is objectionable because the bees will not work well while they want to swarm, but are deprived of the power to do so; but if there is anything in this, it is a quickly passing phase, and the damage is soon made good by the extra work they are capable of while they have no young brood.

REMOVAL OF BROOD

The total removal of the brood is much the same thing as artificial swarming, and has the same effect, but the gathering power of the stock falls to practically nothing a few weeks later. That brings no loss if the gathering power is safely transferred to other stocks, but it may be a serious matter if it is dissipated. This is only another way of saying that you cannot make increase during the honey season without reducing your crop of honey, for the honey-gathering power taken from the stock which is trying to swarm will either go to other gathering stocks or to weaker stocks intended for increase. As a violent measure for stopping a swarm it is effective, but it is far better if you can see your way to restoring the strength of the stock when the danger of swarming is past. It is inferior to the artificial swarm in that it does not produce a young queen, and there is likely to be more swarming as soon as the stock is again ready. But if you have several stocks and one of them has had its brood removed and distributed, that stock is likely to be well fitted to

receive the brood from the next that starts queen-cells. The cells must, of course, be removed, or they may be accepted and provoke a swarm in the hive to which they are given.

This wholesale removal of the brood is not, in my opinion, a technique at which anyone should aim, but it can be useful in emergencies when artificial swarming is not wanted. But the removal of smaller quantities of brood before queen-cells are built, so as to delay a stock and prevent it from reaching swarming pitch too early, can be a very useful part of any system of swarm control. This is our old friend Equalizing. Equalizing naturally tends to delay the earlier swarms, although it may mean that many stocks reach swarming pitch together. If equalizing is properly done, the weaker stock always gains at least as much as the stronger loses.

DIVIDING AND REUNITING

The artificial swarm – or the natural swarm, for that matter – which is later deprived of its queen and reunited with the parent stock usually makes a first-rate colony, but the time at which the bees choose to prepare to swarm is not always the most convenient, so some people like to do the same sort of thing without waiting for queen-cells to be built. A nucleus is made from the stock as soon as it is strong enough, and a queen-cell is given to the nucleus. When the young queen is laying, brood and bees are gradually transferred from the old stock to the nucleus, and a little before the main honey-flow the old queen is killed and they are combined. Alternatively, if increase is needed the old stock is brought down to a nucleus and then allowed to build up again during the honey-flow. The results of this system are excellent, but there are a few snags. For one thing, it is very hard to take brood and bees from the developing stock to make the nucleus,

knowing that you are checking the stock without any gain anywhere else. Nor is it easy to make a small queenless nucleus in early May unless it is taken several miles away for a few days to make sure that the field-bees stay with it. If it loses its field bees the brood will probably get chilled and it will be robbed out. It will offer no resistance at all to the bees of the parent stock and very little to any others. And thirdly, you are not likely to have good queen-cells ready unless you have a number of colonies and are doing the thing on a fairly large scale. The results are good, but it is not worth playing with if the early division is going to end in disaster. If you have a nucleus which has been wintered with a young queen, then you are all set to build from the two stocks a really first-rate honey-getting stock and to leave a nucleus for next year as well.

COMPLETE SYSTEMS

Everybody rings the changes on these themes – if, indeed, they do anything about it at all. For myself, I have hinted in the paragraph above at a system I am trying out. It is not yet my standard system, nor have I yet been using it long enough to know whether it is an economic system, for it is costly to winter one and a half colonies instead of one. Briefly, each colony has a support colony. If on British frames, both stocks are in National hives, but if on M.D. frames (and it is for M.D. hives that I really intend the system) the main stock is on eight frames in a twelve-frame hive and the support stock in a six- or eight-frame hive. In the spring the main stock has a queen eighteen months old, and the support stock has a queen mated in August, which means she has done very little work. The support stock is only a small colony, and it profitably takes a frame or two of brood from the main stock. Swarming in the main stock is delayed by four factors:

1. Non-swarming strain.
2. Large brood-chamber.
3. Loss of brood to the support stock.
4. Destruction of cells.

The idea is to hold off swarming till the beginning of June, and there are few cases in which this is not possible. The hives are opened every nine or ten days. At the beginning of June the queen and two frames of brood and their bees are taken from the main stock, and the whole of the support stock (six frames of brood) is added to it. The two frames and queen of the main stock are given (with empty frames) to the support stock, and this is left to build up with the help of its original flying-bees. It is re-queened in August. When British frames are used, the support stock is put on top of the main stock and a third brood-box is needed to take the nucleus from the main stock. If really determined efforts are made to swarm before 1 June the main stock is held queenless for a while before its support stock is added, or some of its brood may be given to any stock (main or support) that can make good use of it, but these cases are very rare.

This is a variant of the double-stock system which used to be in vogue some years ago. I hope to know more about its profitability in a few years' time. Later swarms are rare unless the queen is faulty. They are dealt with by removing the queen.

My main system is still a single-hive system. The hives are all equalized in spring to promote an even build-up and to delay swarming. Much of the equalization is done early (about the end of April) to reduce the amount of work involved. The idea here is to hold off swarming until the critical date (15 June), and, since the majority of the hives are eleven-frame British hives, this is not very easy. Double brood-chambers are rarely used unless a stock is artificially swarmed, but supers are put on as soon as they

are needed. After the first equalization it is possible to spot queens which lack vitality, and these are removed, together with any old queens, and replaced by queens which have been wintered in a few nucleus stocks, which are then used to rear some more queens. The introduction is carried out by taking two frames of brood and one or two others from the big stock after the queen has been killed, pushing the frames up together, and putting the whole of the nucleus stock into the space so made. If the big stock was a bit lop-sided, the nucleus is put on its less-developed side. The frames which have been removed go into the nucleus, which receives a queen cell later.

By about 10 May the single brood-chambers (or seven M.D. frames) are usually well occupied. Queen-cells are thoroughly destroyed when they are found, and this act is recorded. If a stock is very determined to swarm early it is swarmed artificially, but this does not happen to more than one in fifty in most seasons. Towards the end of the month a few new season's queens are available in the nuclei, and those stocks which have started cells once or twice are re-queened with the whole nucleus as described above. These stocks will usually start one more set of queen-cells, but when these are removed they seem to realize they have a young queen, and give up. On the rare occasions when they persist they have to be held queenless or the queen has to be caged for a time in June. After the critical date, stocks are usually held queenless before re-queening, and after the beginning of July they are often given a cell instead of a queen if they are not required to go to the Heather. After the middle of July all swarm-control ceases, but stocks which have a new queen or have never built cells are not inspected after the end of June.

The treatment of stocks during the swarming season is the subject on which beekeepers have the least agreement among themselves, and most will want at least to modify

some system for their own purposes. For the best system depends not only on the bees and the district, but even more on the temperament and ability of the beekeeper. These systems I have given are merely the expression or one beekeeper's temperament, and he is constantly modifying them. They are given only as examples. But a little learning is dangerous here; the more complicated the system the more experience it needs to carry it through without accidents. For the beginner it is enough to practice artificial swarming.

Chapter VII

HANDLING SWARMS

Having strongly advised you in the last chapter to preserve your peace of mind and have nothing to do with natural swarms, I am now provoking you by talking about the handling of this nuisance which I have already spirited away. You can say, if you like, that I have no confidence in my own nostrums, or at least no confidence that I have described them well enough for you to make them work, and there is something in this; but there are also those swarms that come from other people's hives that you will want to take for your own use, and those that you will be cajoled into taking for your friends and neighbours once your reputation as a beekeeper is established. There are many, too, who treat beekeeping as a pure hobby and are more interested in the doing than the results, and to them beekeeping without swarms would be like gardening without dirt, for the catching and hiving of a swarm can be a very fascinating sport if you have plenty of time for it. It is not quite so exacting as the hunting of wild stocks by watching the flight of bees to and from a tin of syrup, which needs even more than a fisherman's patience, but a swarm will always get its own back on you if you try to hurry it.

Practice may not be so easy, but the principle of catching a swarm is straightforward. If you can catch the queen and leave her in a place where the other bees can find her, you have the swarm. They will find her over a considerable area – fifty yards or more sometimes – but generally the closer she is the quicker they will find her. If they cannot find her they may make several new clusters, but they will all be restless with bees running rapidly all over them and hunting up and down the branch on

which they are; and it will not be long before they begin to go back to the hive from which they came. A swarm which has been caught in a skep or a box and not shut in will begin to work, and the flying-bees will mark the position of the skep, but they do not mark it so firmly that they return there on the following day, after they have been hived in their proper hive.

SWARM-TRAPS

Since the first job is to catch the queen, some people try to trap her by hanging a sort of miniature hive with three frames in it in front of the hive. The bees of the hive have to pass through the bottom of the miniature hive to go in and out, and the outer entrance is made of queen-excluder zinc. When the swarm comes out the queen cannot get through this, and is forced up into the top of the trap, where her bees join her. I have little experience of this device, but I can think of a number of reasons why it is more trouble than it is worth once you have learnt to find the queen. It would have to be in place for several days before the swarm came off, and during this time the drones, unable to get through, would be cluttering up the zinc in their efforts to get out. It would waste effort by knocking some of the pellets of pollen from the bees' legs as they came through the slots, and, although the queen would probably be caught all right, many of the swarm-bees might rejoin the parent stock, and the swarm would be smaller than it ought to be. It cannot be used as an insurance against second swarms, because, if the bees decide against a second swarm, the virgin queen cannot fly to mate.

CLIPPED QUEENS

Some beekeepers make a regular practice of clipping the wings of all their queens. It is quite easy to do, either by

holding the queen by one pair of wings and snipping off half the other pair with nail-scissors, or, if you have more confidence, by holding her by the thorax and cutting off a third of both pairs of wings. The thorax is very strong, and is not likely to be damaged by the fingers. The idea is, of course, to prevent the queen flying with the swarm; the clipping has no effect whatever on the issuing of the swarm. It may even be true that the bees are slightly more likely to supersede a clipped queen, because she in some way seems older to them. Manley thinks this is so if one of the wings is severely clipped, but not if both wings are slightly and equally clipped. If it is so, there is just a trifle more probability that a clipped queen will swarm than an unclipped queen, since the desire to supersede is one of the motives behind swarming. But there is hardly enough in it to influence your decision whether to clip your queens or not.

When the swarm comes off, the queen falls on the ground, nearer if she cannot fly at all, farther if she can fly a little, and the swarm usually clusters on a bush in the ordinary way. When they find they have no queen they disperse, and either find her on the ground or go back home, or some do one thing and some the other. In any case, they ultimately desert the queen when they find she cannot fly, and come off again as soon as the first virgin queen can fly.

The advantages of clipping are that a swarm cannot come off unexpectedly and get away, and this is a great help where the bees are not overlooked, as in an out-apiary, and that the interval between inspections can be a little longer because the margin of safety is increased. The danger is that by making use of these few extra days you may muddle the queens. You open a hive say fourteen or fifteen days after the last inspection, and you can see from the large population and the empty queen-cell

that there has been an abortive swarm and that the bees are waiting for the first virgin to fly. But if one queen has emerged, some of the others are ready to emerge, and are imprisoned in their cells, and while you are manipulating to make an artificial swarm, some of these will escape their guards and emerge. Whatever you do then there is going to be a risk of swarming; if you divide the stock, both divisions may contain several queens and both may swarm.

So long as clipping is used only as a protection against swarms coming off early, when the cells are hardly sealed, it is excellent. At one time I used to clip all my queens, and I stuck silver paper on their backs with celluloid to make them easy to find; but I gave up both tedious practices when I found that I lost practically nothing by not doing so. But for anyone who cannot be sure that he will get to his bees at the right time, clipping is a great safeguard, and it has an indirect advantage, in that it marks the queen, and so shows you for certain when she has been superseded in autumn without your knowledge – which happens quite often even when no queens are kept beyond their second season.

CATCHING THE SWARM

If the queen is neither trapped nor clipped, the only way to get hold of her is by catching as much of the swarm as you can in a skep or box and putting it down as near as possible to the place where it originally settled. Prop it up with a stone, so that the bees can go in and out, and watch to see whether the remnant of the swarm enters the skep, or the bees in the skep test your sense of sportsmanship by rejoining the queen in the awkward place from which you have just brought them down.

The easiest swarm to take is one that settles on a slender branch of a tree you do not particularly value. Naturally

it does not often happen; the bees much prefer the only branch of your favourite apple-tree that has any fruit on it. But if you can spare the branch, first prepare the permanent hive and put an empty super on it (or just the upper lift if the hive is a W.B.C.). Hold the branch just above the swarm, and cut it off with secateurs as close to your hand as you can. Brace your wrist, because a swarm can be heavy, and pull away violently if you are not ready for the weight. Take it to the hive and lay it gently on the frames, and put the roof on before many bees have taken wing. You must look at it towards evening to make sure it has not clustered under the roof. If it has, take out some of the brood-frames and slam the roof down so that the swarm goes to the floor.

If the branch is small but cannot be cut off, you will have to shake the swarm. Hold the skep in one hand and shake the branch with the other – shake it really sharply. The bees will go all over the place, but quite a large share of them will go into the skep, which you will then turn right way up on the ground before you retire to take stock of the situation. If you cannot see yourself doing this, wait until no one is looking, and shake the branch with some long-handled tool, a rake or a hoe, and then quickly put the skep on top of the largest clump of bees. Your chances of getting the queen at the first shot are directly proportional to your courage. If you miss her, the swarm will probably re-form where it was, but it may decide to move out of reach.

If the swarm is on something which cannot be shaken but you can support a skep immediately above it, do so. This covers such places as tree-trunks or thick branches below crotches, horizontal branches, thickets, fencing-posts and so on. The bees may gradually work their way up into the skep, but they usually take no notice. But a little smoke puffed gently and persistently around the

lowest bees will gradually drive them up, and you can steer them with smoke as well. Make sure they have bridges of twigs or leaves to lead them to the inner walls of the skep, and do not get smoke all over the place, or they will take wing. Some of the bees are sure to be on these twigs when you lift the skep down to try your luck, but you can sometimes cut them off and lay them beside the skep on the ground.

Swarms plastered on the side of a big tree-trunk or on a wall are more difficult. If you want to move them quickly you must in some way scrape them off, and it is precisely this scraping movement that bees hate most. If your fingers are closed so that bees do not get caught you can push your hand into the middle of a swarm without much risk of getting a single sting, but if you move anything through the bees that may crush or maim them they will retaliate. So if you want to brush them off a wall, use something very soft – a bundle of grass stems or a leafy plant with a tough stem. If time is no object, get a small twiggy branch and tie it to a nail so that its twiggy end hangs right against the top of the swarm. They will usually prefer it and deliver themselves into your hand. Or you can hang the skep in the same way and put something behind it to increase its area of contact with the wall, and try to smoke the bees into it.

Swarms that are out of reach I must leave to your own ingenuity. If ladders will not serve, you may be able to throw a stone which will carry a string over the branch so that you can haul a rope over it and tear it off, or, if the branch is thick, you might try lapping the rope right round it above the swarm and then making it slip down so that it passes between the branch and the swarm. You will not be near enough to notice how much this infuriates the bees.

HIVING THE SWARM

When you have the whole swarm in the skep you can leave it where it is until the evening, but there is a slight risk that it will come out and go where it had made up its mind to go. You can avoid this by tying it in with some very porous cloth like butter-muslin and putting it in a dark place. On the whole, though, it is just as well to get the bees on to their permanent stand right away by putting the skep on top of the frames inside a couple of supers. You cannot bump the bees out of the skep until the sun is getting low or they may take flight, but the skep can be gently carried without any disturbance. In the evening a single sharp knock of the edge of the skep against the edge of the super will send every bee down on to the frames.

Swarms left in the open until evening can be hived in the same way or thrown on to any sort of platform of boards or cloth or paper which allows them to approach the entrance of the hive easily. If in throwing them you have missed the entrance, push a few towards it, so that by fanning with their wings they can call the others to their find. If they are sluggish chase the rearguard with a little smoke.

CARE OF THE SWARM

In making up a hive for a swarm it pays to put in at least one or two drawn-out combs, so that the queen can start laying without waiting for foundation to be drawn out. If you cannot do that, give them some food to speed up the wax-making. It pays in any case to feed a swarm unless there is a strong honey-flow, for there is no reserve, and the queen will not lay well in catchy weather without a steady income. As the establishment of a swarm always involves a race to get a large brood-nest established before

the population falls and the nurses get too old to nurse, a few days lost at the beginning may cost very many bees later on. A good swarm can work at incredible speed during the first week or so if it is not hampered.

Chapter VIII

HONEY-FLOW

There is a remarkable tendency among beekeepers to possess far more supers than they are ever likely to use. Once in June I came across two W.B.C. hives each of which had six lifts above the brood-chamber, and the great expanse of wood was prevented from sailing away in the wind by a system of guy-ropes and tent-pegs. They were nearly 8 feet high, and the owner must have needed a step-ladder to get at them. At this time most of my bees had done nothing in the supers, and the average yield of surplus honey in the district turned out later to be 12 lb. for the whole season. His super capacity must have been 300 lb. for each hive. Of course, he may have been an expert, with secret methods unknown to the rest of us, but I hardly think so, or he would not have made it so difficult to work his hives. Perhaps someone had told him that bees do not swarm if they are given unlimited space, and he was making sure it really was unlimited.

It is much better to have super capacity which will comfortably cover the average yield of your district and to have your own extractor than to have enough supers for a bumper year and depend on someone else's extractor. An absolutely first-class year comes only once in about ten years. It is not worth having capital waiting about and deteriorating for this rare use, when the extractor will allow you to use the same frames as often as they are needed; and you need not be afraid that this will mean extracting honey before it is fit. These good seasons always mean complete frames of honey all more or less sealed at the same time.

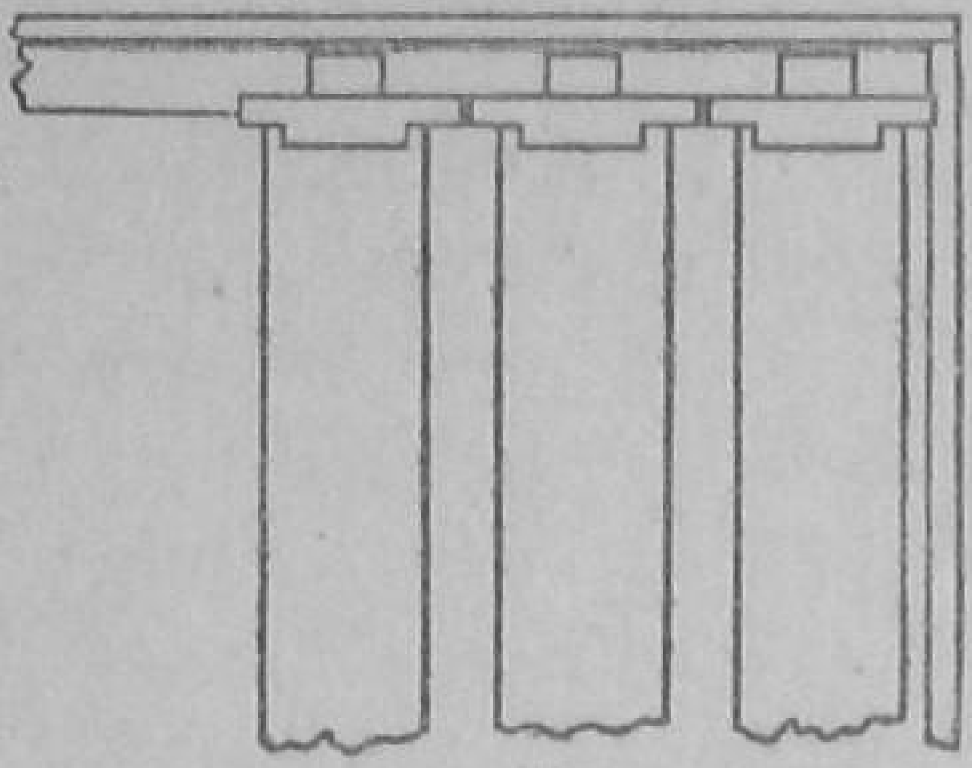
AVERAGE YIELD

According to the returns which beekeepers themselves send in, the average yield of surplus honey in an average district is not likely to be much above 30 lb., so you can manage with super space to hold 50 lb. for each hive if you have an extractor. When double brood-chambers are used, or the supers are all of large capacity, a little extra should be allowed, but the double brood-chamber itself can waste a great deal of space if the queen is not made to occupy the lower half later in the season. I have often seen such a hive in July with plenty of brood in the upper chamber and one or two supers of honey above, but with the lower chamber almost completely deserted and empty. One of those chambers could have been a super, and the stock could have managed with 50 lb. less super capacity. The time to buy extra supers is when you find that your honey-yield is consistently above the average for the district.

SUPERS AND FRAME SPACING

There are three patterns of super that concern us: the M.D. shallow frame super, the British shallow frame super and the British full depth super. The last is identical with the brood-chamber and is interchangeable with it, the other two are specially built as supers. Whenever it is possible, it pays to use a wider spacing in supers than brood-chambers, so that they hold nine frames only instead of eleven. This reduces the number of bee-spaces between the frames and allows the super to hold more honey, and it also makes the frames easier to handle when it comes to uncapping them for the extractor. It is an advantage if these frames can have their woodwork a little wider than the brood-frames and have the bottom bar as wide as the top bar, so that the two together can guide the

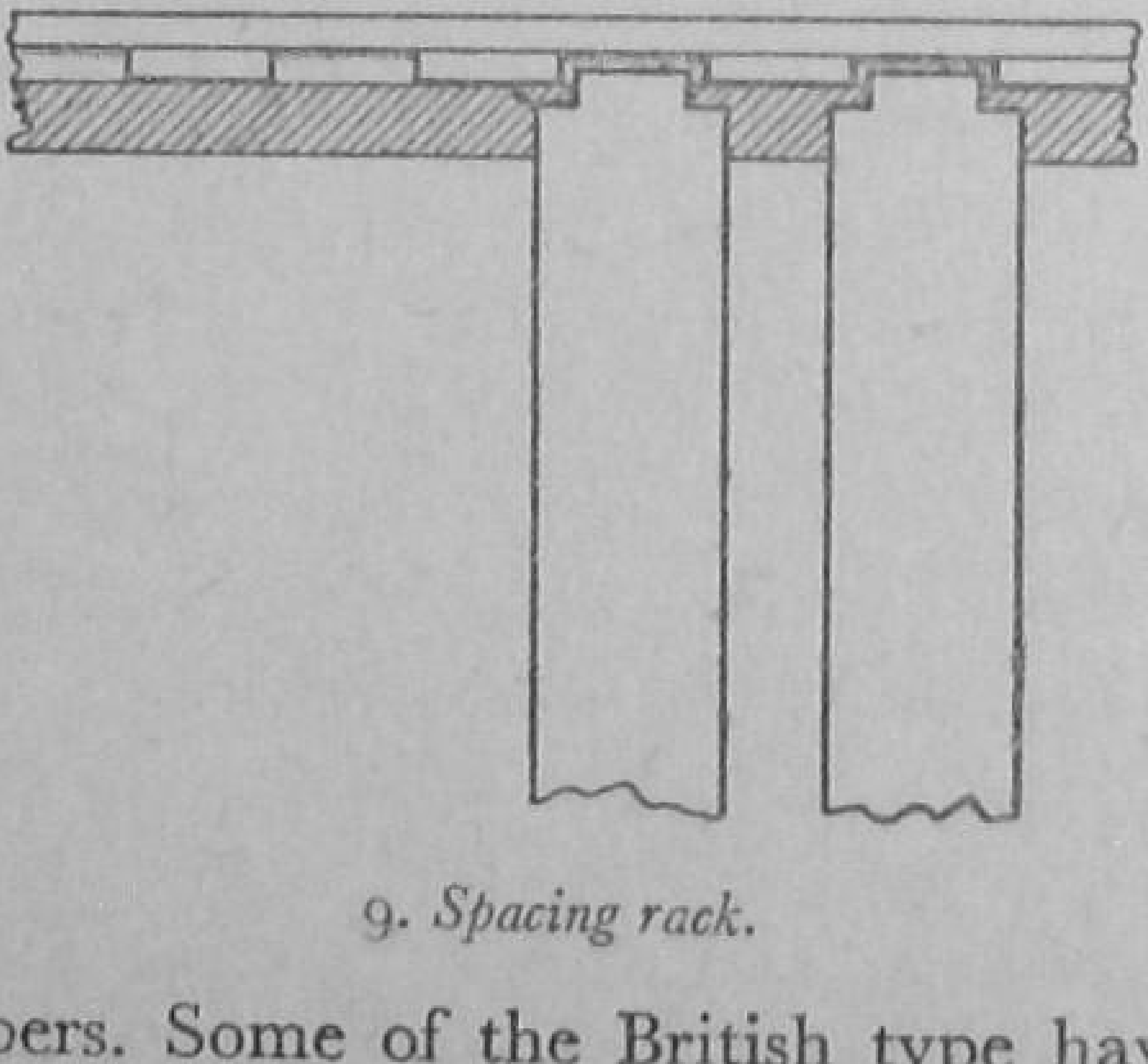
uncapping knife. This extra width can be got in full-depth supers by using wide metal ends instead of the narrow ends of the brood-chamber, but when a box is used first as part of the brood-chamber and later as a



8. *Wide metal ends.*

super it is not possible to make a change. Brood-chambers should never be wide-spaced because the large gap has to be kept warm for no purpose.

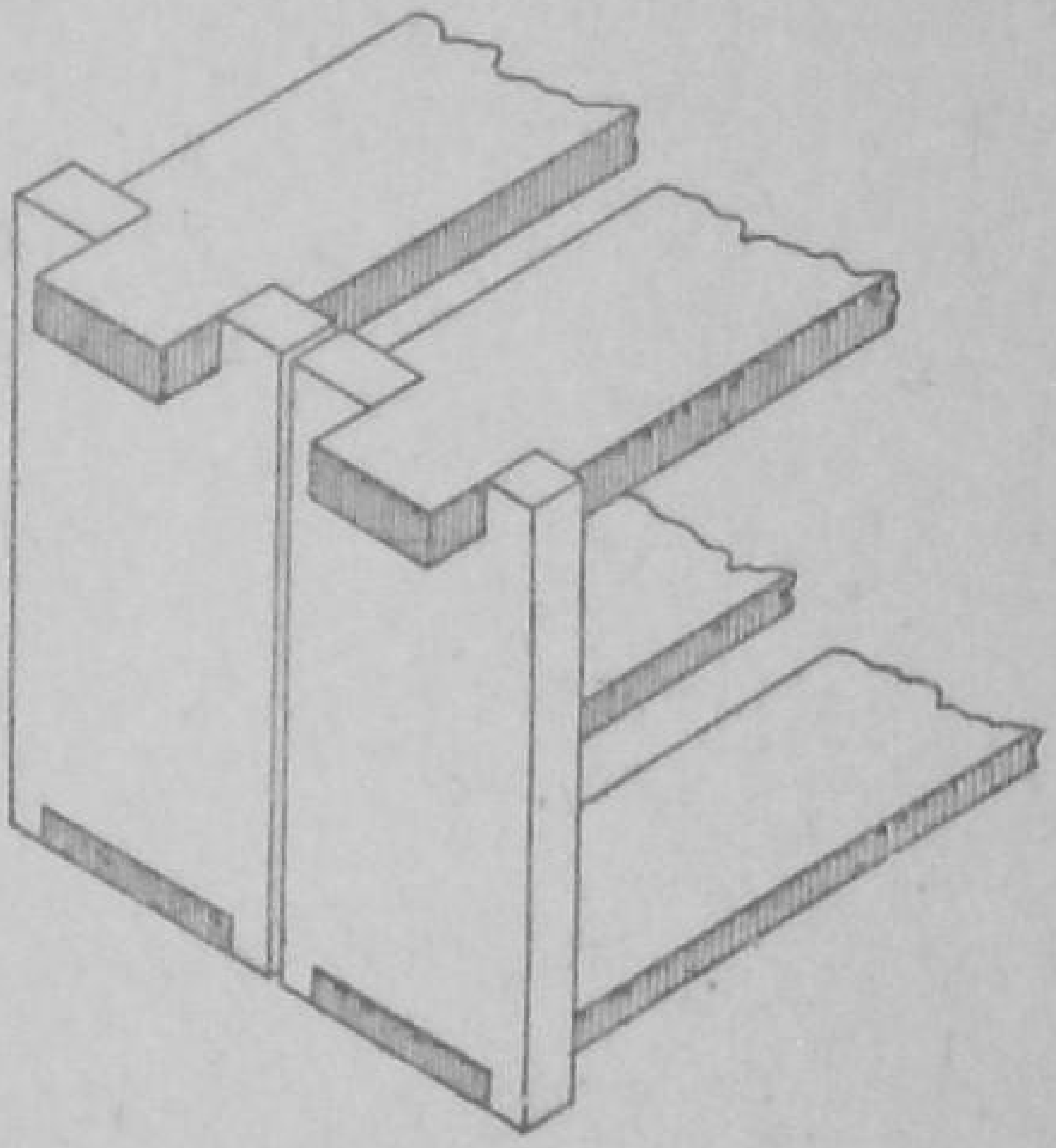
There are various methods of spacing the frames in



9. *Spacing rack.*

shallow supers. Some of the British type have a metal runner and metal ends just like the brood-chamber. This makes it possible to use ten frames instead of nine (in the eleven-frame hive) by using alternate wide and narrow metal spacers, which helps if all the frames contain only

foundation, for in this case the bees are liable to build some comb between the frames. There are also close-end or self-spacing frames whose end-bars are wider than the top and bottom bars, so that they have just to be put side by side to give the right spacing. A third common method is to rest the lugs of the frames in niches cut in a strap of metal or wood, the Spacing Rack. With these last two methods you either have to accept the bit of mess you may



9A. *Self-spacing shallow frames.*

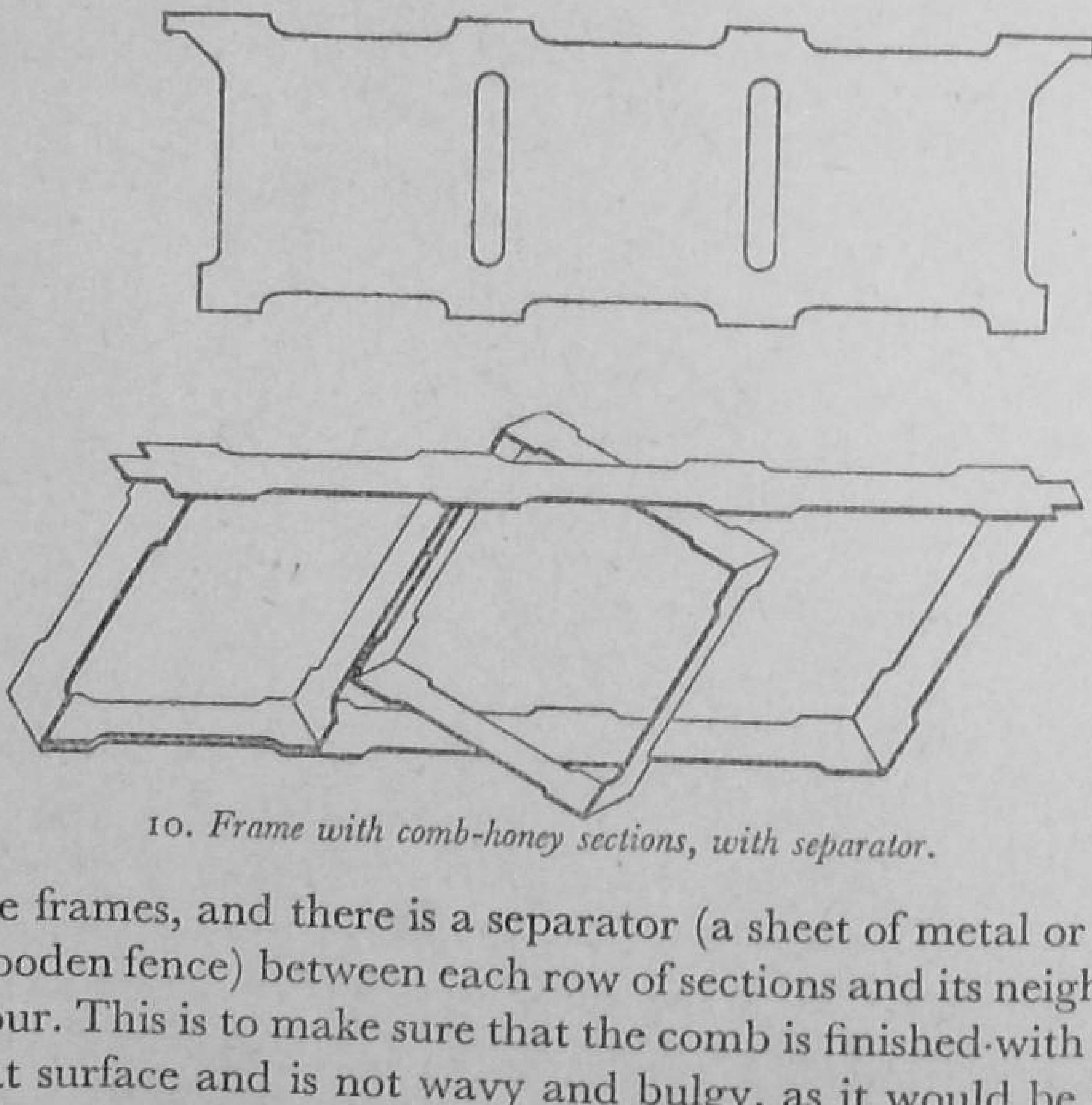
get the first time they are used or alternate drawn combs with combs of foundation.

Metal ends are adaptable, but they let the frames swing badly if the full super has to be transported. Sometimes they get jostled out of position and one gets across its neighbour or even on top of it. They are also a nuisance at the time of extracting, when they all have to be taken off and put on again. Self-spacing frames are absolutely rigid in transport, and they are not much trouble to prise apart, but the comb is rather more liable to get broken in the ordinary (tangential) type of extractor because the

wide end-bars prevent it from being supported by the gauze of the extractor reel. The frames which rest in niches are not fully rigid in transport, but they have no other disadvantage, and as the combs never seem to suffer more than a slight bruise when they swing against each other, I prefer them to any other pattern. But if you are just keeping a few stocks at home, so that transport does not enter into it, and there are not many frames to handle, it really matters very little.

SECTION RACK

The special super which is used for producing comb-honey has three or four 1 lb. sections in the place of each of



10. *Frame with comb-honey sections, with separator.*

the frames, and there is a separator (a sheet of metal or a wooden fence) between each row of sections and its neighbour. This is to make sure that the comb is finished with a flat surface and is not wavy and bulgy, as it would be if one side developed faster than the other.

It is more difficult to produce sections than extracted honey partly because the bees have to build new comb every time, but even more so because the bees hate sections and have to be driven into them by shortage of space. This can make a well-behaved colony swarm when it would not have dreamed of swarming otherwise. There is the further trouble that you are bound to get a lot of unfinished sections which either have to be eaten as they are or extracted and carefully stored until the next year. Taking one thing with another, I reckon that a good section would need to be worth double the price of a pound of honey before I should be tempted to produce it. The usual price difference of half as much again does not cover it. But if anyone wants to produce sections for his own use, he can obviate the swarming trouble by putting them on a hive which has already swarmed or is in some way proof against swarming, or he can wait until the main honey-flow has really started, and put a rack in place of an occupied super, giving the super to another hive. If honey is coming in fast the bees will be obliged to occupy the section rack, and once they are in it they will probably go on working there even if the flow slows down.

SUPERING HIVES

Supers should be put on as soon as they are needed either to receive honey which is coming in or to provide space for the bees when their increasing numbers make the brood-chamber too small for the cluster on warm days. They must never for a moment at this season be allowed to feel that their hive is nearly full, though later in the season, when the emphasis is on winter storage and they have passed the propagating stage, it does not matter, so long as they have some little space to put their honey in. If a second brood-chamber is used or if the brood-

chamber can be expanded sideways (as in M.D. hives) there is usually no point in supering until the main honey-flow approaches, but the eleven-frame British hive presents a problem, because it often needs a super for extra space at the same time as it needs feeding to keep up the reserve. When this happens there is no harm in feeding on top of the super or removing enough of the frames to house the feeder in the super, so long as the syrup is not stored in the super, but if this does not meet the case you can put the super temporarily under the brood-chamber to give the cluster space until the feeding is finished.

QUEEN-EXCLUDER

It is hard to manage a British hive without a queen-excluder, but I do not think it is essential in an M.D. hive, provided that there are nine or ten frames in the brood-chamber. In the small hive the period of rapid expansion of brood finds the upper part of the hive occupied, and brood may be carried right up the middle of the hive in the shape of a cylinder, but in the large hive the super is very probably not occupied and the brood-nest remains spherical. When, in June, the queen has a chance to go up, the main expansion is over, and she just lays a few patches of eggs and goes back to the large nest below, which is always demanding her attention. The deep, wide top bars of the brood-frames are also a deterrent. The excluder does not have much effect in delaying expansion of the cluster, but if you are in doubt about this you can always let the bees come up first and put the excluder in afterwards. When a double brood-chamber is used the excluder should be put down between the two chambers about the beginning of June. If there is much unsealed brood in the lower chamber, some of this should be transferred to the upper chamber, and sealed brood

concentrated below, so that the queen is bound to have plenty of cells to lay in until after the critical date. Sometimes the two chambers may conveniently be exchanged. If you cannot find the queen to make sure she is below, come back three days later, and you can see from the eggs whether she is in the right place. If you have several M.D. hives it is perhaps just as well to have one excluder to deal with those rare cases where the queen really tries to establish herself upstairs, and so make sure that all supers are free of brood when you want to take them off.

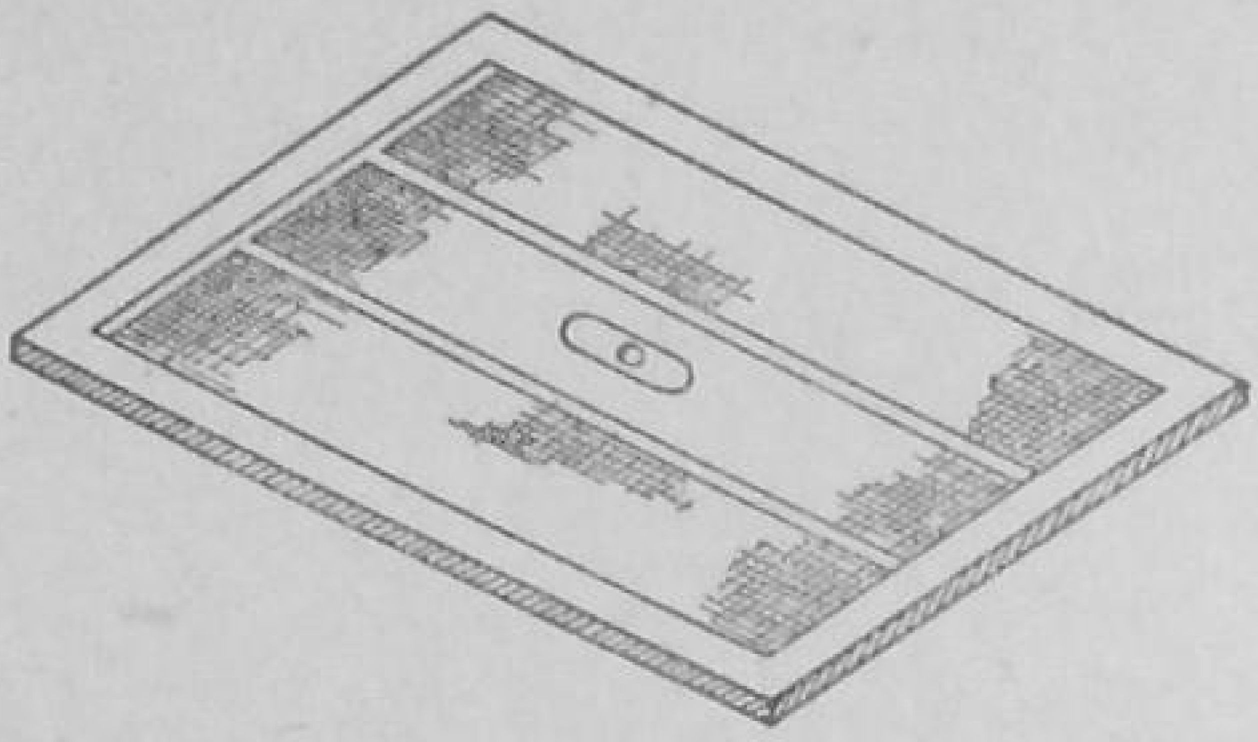
SECOND SUPER

The earlier it is in the season the quicker you should be to put on a second super if you think it is justified. In early June put a second super on top of the first as soon as the bees have taken full possession of the outside frames; in July there is no need to put one on until the first super is two-thirds full of honey, which is a very different story. You want to avoid, at the end of the season, having about four supers on the hive each containing two full frames and several part-filled frames, with nothing in any of the outside frames. The bees, too, find this unsatisfactory, and are likely to empty the part-filled frames and store the honey in the brood-chamber. They value dispersal in the early part of the season and compactness later on. They do not like the idea of defending a large perimeter against wasps and robber bees in the autumn. Many people put the second super under the first, but, unless the colony is very strong and there is a good honey-flow, this may lead to storage in the brood-chamber or in the centre-frames only of both supers. It is better to put the second super under the first after the bees have started work on it, and then the full frames will be on top if the season is good and you want to extract any. Unless a good season fills up all your frames or the demands of the tea-table cannot be

resisted, it is as well to leave all the honey on the hive until the end of the season.

REMOVING HONEY

Odd frames can be got by bumping off most of the bees and brushing off the last few with a bunch of grass; whole supers are best removed by using a clearer-board. This is a board which completely covers the brood-chamber and



11. *Wire cloth super clearer-board, which is also used for confining bees when they are moved.*

11A. *Bee escape, with parts of the top removed to show the little springs which allow the bees to go downwards, and prevent them returning.*

has a bee-space under it (often it is the crown-board of the hive); in it is an ingenious little valve, the Porter Bee Escape, which allows the bees to pass downward into the hive and prevents them from coming back. When it has been in place overnight there are hardly any bees left above it, sometimes not a single one. The only trouble with this device is that if there is any hole at all by which

the bees can get into the super from outside they will be there in force as soon as the guards have gone.

Unripe honey is a nuisance because it ferments after extracting. It is simply honey which has not yet had the surplus water removed from it by the bees, or honey which was fully ripened but which has been left about in a damp atmosphere and has attracted water to itself again. The second sort you will not find in a hive in the summer; the first sort is easily avoided by not extracting frames during the honey-flow unless they are 95 per cent sealed over (since the bees do not seal honey until it is ripe), and not extracting the unsealed honey at the end of the season until about a week after the end of the honey-flow. I cannot give a date for this, because there are sometimes August flows from Red Clover and other plants, but the end of the first week in August would usually be safe.

When the nectar first comes into the hive it may be more than half water, and a good deal flies out of the frame when it is shaken, but shaking is not a good enough test for ripeness, because the honey will refuse to leave the comb when it is still very unripe. There is no harm in leaving the honey on the hive until September, but by that time a great many of the unsealed cells will have been emptied and the honey stored in the brood-chamber.

HONEY WEATHER

Different plants need different weather for their best yield, but they all need reasonably warm weather. Hot weather is no better than warm weather, and both great heat and dry air tend to shorten the period of honey-flow by taking from the plant and from the soil the moisture which the flower must have to make its nectar. That is not to say that a long spell of fine dry weather means a poor honey season, but it is not ideal. We remember bumper honey

years as blazing summers, but if we look up the records we find that there is usually a good deal of rain in May or early June, so that the season starts off with a good reserve of moisture in the ground, and that afterwards fine spells of a week or ten days alternate with short breaks of rain. Naturally, a good deal depends on the nature of the soil, and in a very dry year the more retentive soils hold out better than chalky soils or those that are shallow over rock.

It is not a precise thought, of course, but I like to think of honey seasons over a period of ten years, and to say that in that time you will get the full range of honey seasons, one bumper, when a good beekeeper may average 100 lb. or more; one failure, when only the best districts have any yield at all; and all the other qualities from two to nine scattered about over the period. Because of the differences of soil and climate the arrangement will not be the same in one place as another, but if you stay put the seasons will come round to you. If I may illustrate from my own bees which are kept on chalk land or chalky clays, I would put the last five years as two, ten, four, nine, and three. 1945 had a wet June and a dull, warm July. The bees built up very well in the spring, and after the rain the clover yielded as fast as the bees could carry it. But in many districts the crop was poor. 1946 had about ten days of honey weather, but few beekeepers had enough sugar to keep the bees going through one of those Junes when the bees run their reserves right down and still cannot maintain their brood. It went on raining through August, too, and spoilt the Heather crop. The yield was as near nothing as no matter. 1947 started late after a bitter winter, and then became too dry in dry districts. When the weather was not hot and dry during the honey season it was cold and dry, and the honey-flow was finished by 20 July. 1948 had its summer in March, April and May. A great deal of honey was gathered from trees

and other early flowers, but except for three days in June and five at the very end of July, the whole of the main season was dark and cold. Generally it is true that if the spring is very good you will pay for it in the honey season; the best seasons are usually those in which the beekeeper has a struggle to get the bees built up to strength. 1949 had a rather difficult spring, although there were several warm spells. Low temperatures at the end of May and during the first few days of June checked the build-up badly. June 5th to 25th was fine weather, warm enough for Charlock to yield but not really warm enough for Clover. The next ten to fifteen days gave a really good Clover yield, but after that yields were small because of drought. Two inches of rain in early July would have made it a season to be remembered long. As it turned out, yields were very good where Charlock or some other plant could take the place of Clover in June; otherwise they were not spectacular.

In a good White Clover district, where there is Charlock on cultivated ground and perhaps a little Sainfoin to help out in early June, the potential main season is fifty to fifty-five days. If there are plenty of Holly-trees, or a field of Cabbages or Brussels Sprouts grown for seed, the season may be seventy days. If you tick off the real honey days during the season – days when the flowers are dry enough to work and the temperature is up to 70 degrees, and the wind, if there is any, is southerly and moist – their number will give you a very good idea of the crop. I suppose a very good season would have forty-five days out of the fifty-five, though a few less might make little difference, since the bees are aged by work, and on wet days they are not aged much, and can give that day's work later on. Certainly a crop not much short of the best can be got in thirty to thirty-five days, especially if those days are more in July than June, for the July bees are

wasted if July is wet, but the June bees can do their work in July if June is wet. About the average crop is got in twenty days, but ten days or less always means a poor season; it is rare to find a season that does not give ten days, since dry, cloudy days in July are often warm enough, but we have to remember that the average temperature in summer is only just high enough, even in the south, for a honey-flow, so a good honey-year has to be warmer than the average or else entirely equable, with hardly any change of temperature from day to day.

A hive kept on scales and weighed every day gives the story, and sometimes the success or failure of any one day is hard to account for, partly because the evaporation of the old nectar is going on side by side with the gathering of the new, so that you get results like this:

July 10.	minus ½ lb.	Wet, cool
11.	plus 12 lb.	Fine, warm
12.	minus 5 lb.	Wet, windy
13.	minus 1 lb.	Drizzle, cool
14.	minus ¼ lb.	Showers, cool
15.	plus 10 lb.	Dull, warm
16.	plus 4 lb.	Fair, warm
17.	plus 5 lb.	Fine, warm
18.	plus 3 lb.	Fine, warm
19.	minus 3 lb.	Wet, cool

The heaviest gains are usually registered when a fine day follows rain, because at this time most of the nectar has been evaporated during the wet spell.

But without any scales it is easy enough to tell when there is a honey-flow. As soon as it begins in the morning the bees leave the hive in a steady stream, and they come back obviously loaded. They fly more slowly than usual, and a few land, panting, on the hive roof before they attempt to reach the entrance. The note made by their

wings is lower, and there are so many in the air at any time that they make a continuous low drone, and it can be heard at some distance. There are no entrance guards, for in a world of plenty there are no robbers. Work goes on very late if the evening is warm, and bees will still be coming home as the sun sets; and after they are all in you can hear a great number of bees fanning, as they draw in fresh air to replace that which is saturated by the evaporating nectar. The smell of this air coming from the hive can tell you what is the source of nectar, although in many cases it is subtly changed from the smell of the flower; the oily sweetness of Holly, for instance, is quite unmistakable, but White Clover smells more like yeasty dough than a Clover-field. Most powerful of all, as it still is in the ripened honey, is the smell of the Ling Heather, which you can sometimes catch fifty yards away from the hives.

HONEY PLANTS

Since different plants yield best in different conditions, it pays well if your bees can have some choice. White Clover is a tricky plant, and needs several hours of warmth before it begins to yield freely, so it combines well with Charlock, for that seems to yield better in the morning than it does in the heat of the day. Towards the end of the season Bramble combines with Clover in the same way, and the bees will work the Bramble all day if the Clover does not out-yield it. The Rosebay Willow-herb that grows in newly-cleared woodland or any site which is not already overgrown is also a steadier yielder than the Clover. Lime-trees are even more sensitive than Clover, but when they really yield they out-yield anything. Being deep-rooted, they do not mind drought; but, since they belong to a climate warmer than ours, they need exceptionally warm weather and a moist air. In hot, dry weather they only beat the Clover in the

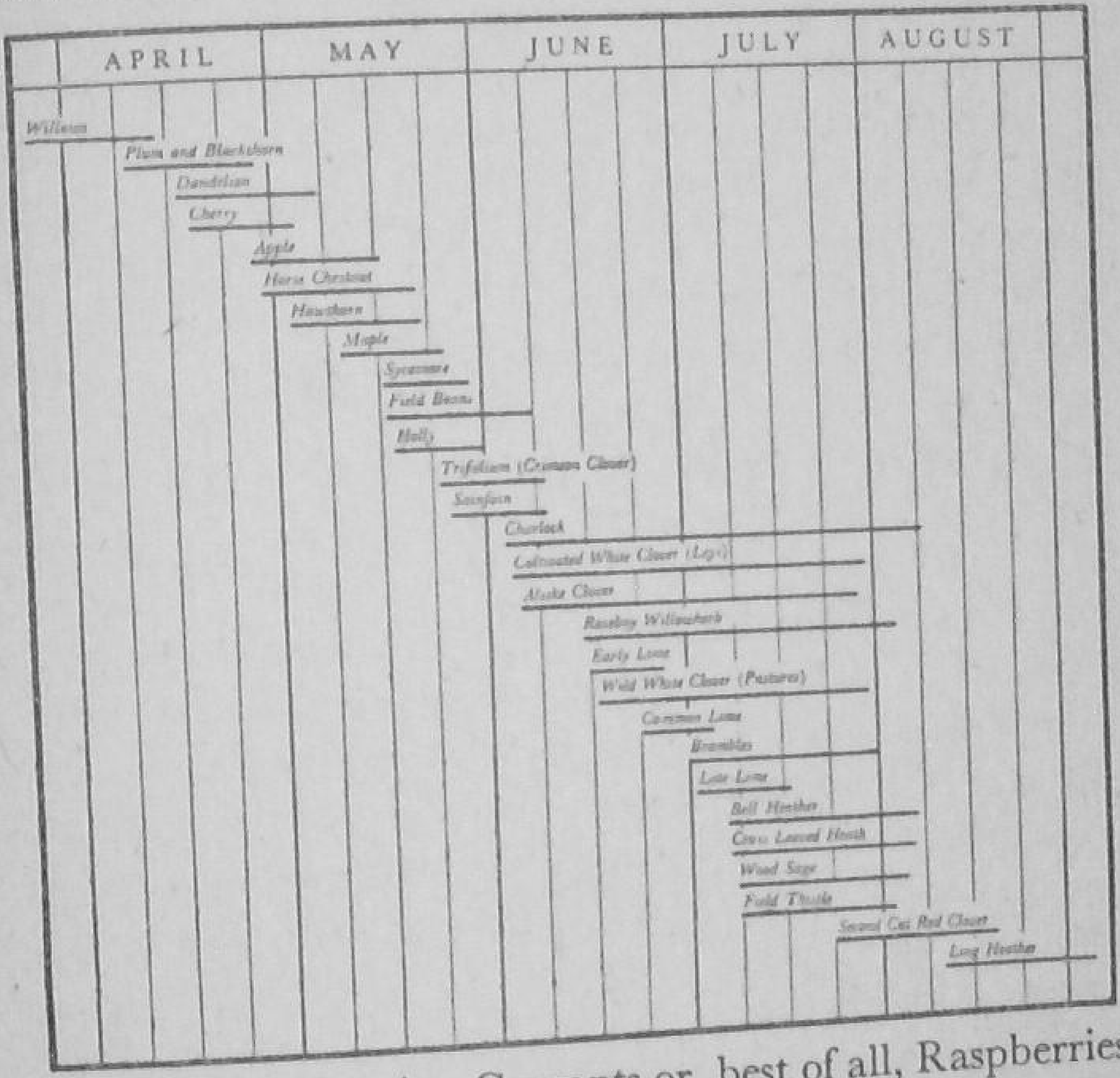
morning and evening, but they often make the difference between crop and no crop where there is no Clover. There are several different kinds of Lime with different flowering periods, but usually only one is available, and there are only about ten days when honey is possible; only too often it happens that the special weather it wants does not come at all in this short time. All these honeys blended with Clover honey make, in my opinion, a better honey than any of them are separately. On some soils even Clover itself can be a little insipid if it is too pure, although it looks very attractive. All honeys tend to be a little stronger and darker when the plants grow on strong soils and clays than when they grow on light soils, so that any sample of honey differs endlessly in blend and quality from any other, just as the Cider of one farm differs from any other in the multiple combinations of different soils and different varieties of apple.

There are times when honey can be got in quantity from many different kinds of flower and no great acreage of any one, but usually there are just one or two kinds in profusion for which the bees neglect all others because these are the quicker yielders. But there are quick-yielding plants which are not, unfortunately, ever common enough to make a honey-flow, such as Catmint and Lavender in gardens. These plants, which are good but scarce, will get attention from the bees even when they are getting a good flow from one of the common honey-plants; but they are not important plants, because they contribute but little to the crop. There are others, such as Apple and Hawthorn, which may be plentiful enough, but which often yield nothing even when conditions seem to favour them.

I have made a chart to show the flowering periods of our common honey-plants, but it should be read according to the season. Especially in the early months, the

dates are uncertain – the date when Apple-flowers open varies by as much as a month.

The early sources of honey which do not often contribute to the actual surplus may be of immense value in helping the build-up of the stocks. I have not included in the chart those specialist crops which are found only in a few areas, but any beekeeper whose bees can get at a



field of Gooseberries, Currants or, best of all, Raspberries is indeed lucky. Cherries, both wild and cultivated, also yield well, but Apples, if they are to yield freely, seem to need more warmth than they usually get. I take some of my bees every year to help set the fruit in some Apple orchards, and the arrival of the bees is the signal for the growers to get out their mowing-machines to cut off the Dandelions under the trees, which the bees much prefer as a source of nectar, partly perhaps because the Dan-

delion nectar is much thicker and sweeter than the Apple nectar. An old Maple-tree, too, was removed because it was distracting the bees from earning their keep. But the growers do not really need to worry. For pollen-yield the Apple beats the others hollow, and in May they need enormous quantities of it. There are literally hundredweights of the creamy stuff in the hives when they come home. Hawthorn is shy in the same way, rather more so, I think. But when May is a hot summer month, as in 1948, it yields well. I believe that is the first time I have ever seen a real flow from it.*

The trustworthy plants of the building-up period which can be relied on whenever the weather is right are Blackthorn, Dandelion, Cherry, Horse Chestnut, Maple, Sycamore, and Holly. In my experience Holly is the best of all these, although its season is very short; in fact, I believe that, within its limits, it is the best honey-plant we have. I remember that in the amazing honey season of 1933 twenty-five stocks gathered 400 lb. of surplus from a small patch of Holly-trees which could not have been more than half an acre, and was nearly a mile from the apiary. Very odd stuff it was, too, strong and oily and not everybody's taste, but when blended and matured it made a very good honey. Unfortunately, Holly, like Lime, does not grow much on the best Clover soils, though it is sometimes found on the sweeter clays where Clover can be fairly happy and Brambles luxuriate.

Sainfoin, which is grown for hay on chalk and limestone soils, is one of our best honey-plants, but not nearly so common as it was. It may, perhaps, return when downland farmers do not find it quite so easy to pay their way with barley grown for brewing and have to keep more livestock. The mowing-machine makes its season very

* This hawthorn flow was repeated in 1950, and was followed, as in 1948, by a most unpleasant summer.

short, but where it can be found it has the great virtue that it helps to fill the gap between the spring flowers and the main season, the 'June Gap', which can be such a nuisance to the beekeeper in his swarm control. Field-beans do not usually yield very heavily, but they are grown on heavy soils, so they do not compete with Sainfoin. Crimson Clover is, I think, even rarer than Sainfoin, and is cut earlier.

In most places, during the June Gap, the bees are thrown on to minor sources of nectar. If the weather is good they maintain themselves, and even gain a little; but there is no proper flow, and that is very disappointing, since good weather is so rare. When I lived in a district of upland pasture I found the gap very marked. There was very little for the bees from 1 June to 15 June, except odd plants of Hop Clover and the early flowers of Bird's Foot Trefoil. But I find it very different now that my White Clover is mostly of the cultivated sorts (Aberystwyth S. 100 and New Zealand – the successors of the old Dutch White) and is grown in temporary pastures, sometimes even grown for seed, which makes a beekeeper's paradise, in which he is as popular with the farmer as the farmer is with him. These Clovers can produce a flow ten days before the wild White and, with Charlock in the corn, can nearly close the gap. The new selective weed-killers, which kill the Charlock without damaging the corn, are a good wind which blows somebody some ill, but fortunately they are expensive, and modest crops of Charlock are allowed to stand. It is a most irrepressible weed, which seeds so freely that it is hard to believe the farmers will win a decisive victory over it, especially as its seeds can live for a generation while they wait for the plough to turn them up again.

Alsike Clover – the tall, pinky-white Clover which is sometimes sown with Red Clover in cultivated

hayfields – also flowers in early June, and is as good as White Clover, but Red Clover is a plant which is adapted to the bumble-bee rather than the honey-bee, and yields little at this time, although it is a good producer of nectar. On some soils in some years the second crop (which is often left for seed) yields freely in August.

Beside the Bramble and the Willowherb, there are one or two other plants which help to eke out the season if the Clover fades early. Ragwort contributes a rather unpleasant honey in dry years, and Field Thistle a pleasant one which is sometimes plentiful for a few days. Some districts have still later sources. In mine the Marjoram and the Red Bartsia can keep the hive in balance in early August, but there is no flow unless Red Clover yields. Ling Heather usually opens enough to allow a flow by about 10 August, and can go on into September if there is enough moisture in the ground.

Two of the most important honey-plants of America and Canada are not much use to us. Lucerne (Alfalfa) is grown a little in this country, but does not seem to yield so freely in our climate. It is very deep-rooted and likes great heat. The Melilot, whose lovely name is threatened by the transatlantic Sweet Clover or Hubam, grows a little as a wild plant and is always covered with bees, so it could obviously be very good in our climate, but the farmers do not like its woody stems, and prefer Red Clover. As it can be sown to flower in August and September, I am surprised more farmer-beekeepers do not give it a trial, as it is a bulky plant and the Americans find it good fodder.

HOW DO BEES FIND THEIR NECTAR?

If you move some hives and open them in a strange place where there is a good source of nectar perhaps half a mile away, they will all be working it within an hour or two. So

it is clear that the first bees to find it have some means of telling the others that it is there. If there is a source of nectar near the extreme range of the bees' flight, say two miles away (because of the unmistakable smell of Heather-honey, a patch of Heather makes a good example), some stocks will find it and others will not, which shows that they do not broadcast the news, but give it only to their own stock. This has always been intriguing, and recently von Frisch has unravelled the mechanism of their signals. By dancing little jigs on the surface of the comb, they are able to tell the others either that there is some source close at hand or that there is a more distant source which lies in a particular direction. The direction is given by the angle between the line of a straight walk they do in the middle of the dance and the vertical. The other bees record this angle and also the length of the walk between the two little dances. The angle gives them the extent to which they must bear away from the sun, on one side or the other. The length of the walk gives the distance they must fly. They can see the sun even when it is cloudy. To work this out for myself I should need a protractor and a piece of paper, but the bees apparently do it automatically. Any one who opens a hive shortly after the bees have found a new source of honey or pollen will see these little dances; there are probably a number of them with different meanings. At present knowledge of the way in which bees communicate and make their individual minds work as one mind is scanty. We really only know how they behave in the mass.

HIVE RECORD

To illustrate the information which I find it worth while to keep on the record-cards, and to show the sort of treatment the colonies get, I will quote one or two typical cards in shorthand and in longhand.

The first is the story of a nucleus formed artificially in July by carrying queenless bees and two frames of brood from one apiary to another. I will say more about artificial increase later on.

Jy	20	queenless nuc	The nucleus is made up.
	21	q c giv	A sealed queen cell is given.
	25	em fb giv	This was the latest date for emerging. This is confirmed and a frame of brood is given.
Au	5	47 q	The queen is mated and has begun to lay.
	15	2 f	There is new brood in 2 frames (the stock is being steadily fed with syrup).
	27	3 f	3 frames of brood.
Sp	15	SF	There is now enough brood and enough food to make it likely that the stock will survive the winter. Feeding stops.
	25	CD	Closed down for the winter.
Ap	10	(1948) 2 f	Two frames of brood.
	25	3 f	
Ma	10	f giv 6 f	A brood frame and its bees are added to make 6 frames of brood.
	20	y cell k	A queen cell with a larva in it is destroyed. It looks as though something is wrong with the queen. At this time supersedure cannot be allowed because it is almost certain to lead to swarming.
	31	q failing s cells k	The queen is failing. Sealed cells are killed.
		q rem nuc giv 48 qE	The queen and one or two frames are taken from the stock and a nucleus with an early 1948 queen is put in their place.

Jn	5	eggs k	The stock is still starting queen cells.
	14	–	The young queen is now laying fast and there are no cells.
	25	–	No cells.
Au	1	– (30)	All correct. The crop is estimated at 30 lb.
Sp	25	(H20) F15	The crop of Heather honey is estimated at 20 lb. 15 lb. of thick syrup are needed to complete the winter stores.

1948 gave only eight or ten honey days in the main season and ten or more in the Heather season. In most seasons the main season crop is three times the Heather crop.

The next one is an established stock on M.D. frames.

		48. 47 qE	Season 1948. The stock has an early 1947 queen.
Ap	11	4f	Brood in 4 frames.
	25	f tak 5 f	A frame of brood and bees is taken leaving 5 frames of brood.
Ma	6	f tak 6 f	A frame is taken leaving 6 frames.
	17	f tak 7 f	This stock has exceptional vitality and is helping to build up several others. Another frame is taken.
	26	9 f	9 frames of brood.
Jn	5	eggs k	Swarming attempts begin.
	15	y cells k	It looks as though they will not give it up.
	24	s cells k q rem	The cells are sealed this time and it would be rash to kill them without removing the queen.
Jy	3	cells k nuc giv 48 qE	The cells are killed again and an early 48 queen is given with her nucleus.
	13	–	All well.
Au	2	(40)	Estimate of main crop.
Sp	20	(H20) F10	Estimate of Heather crop. Feed 10 lb.
Oc	5	CD	Close down.

Chapter IX

WINTERING BEES

The actual preparation of a hive for winter is nothing; the work can be done in a minute or two. Good wintering depends upon the food supply, both honey and pollen, the reliability of the queen, the position of the hive, and an adequate supply of *young* bees. If one of these things is wrong, no amount of coddling with double walls, blankets, wintering cushions, and so on is likely to do much to compensate, nor, when you close the hive down at the end of September, can you correct any of them except plain shortage of food. In fact, if you examine the stock at that time there is no real evidence to show you whether the bees are mainly old bees or whether the queen is likely to turn drone-breeder or die. You must lay the foundations of good wintering much earlier in the season.

POSITION

The ideal site for bees in winter is well sheltered from all cold winds, which means that it is open only to the south and south-west, and has a large enough area of sheltered air to allow the bees to take their cleansing flights, and even to collect some water (which is everywhere in winter) without being fully exposed. Many such sites are liable to be too hot in summer or so shut in by trees that they are not good for honey, and in any case there are few beekeepers who can use any site outside the narrow limits of their gardens, so that they have to make the best use of whatever is available. Whatever you do, avoid putting your hives out, for the sake of ornament or the garden plan, on some exposed hillock or in the channel where the north-east wind sweeps round the house. Only too often they are set out in a gloomy row, like tombstones, bearing

the brunt of all the winds that come along. Set them among bushes or fruit-trees if you can, among them but not under them, because this not only helps them to winter well, it also makes them more manageable in the active season, though I am not sure why this is so. It may result from their habitual lines of flight being fixed and vertical, instead of broad and horizontal. Hedges and bushes are perhaps the best shelter, but, if it is most convenient to use a wall, watch out for the eddies which a wall can sometimes cause when the wind which glances upward bounces down again. You are most likely to escape them by putting the hives fairly close to the wall and then shading them against the great heat which will develop in such a site in summer. It is easier to shade than to shelter.

If you live in a place where the shape of the ground gives good natural shelter, all this is of less importance, but it pays to do what you can, especially if you are in one of those narrow valleys which act as a funnel for the wind; but if you enjoy one of those hilltop sites which the house agent describes as a bracing situation, you may have to think of some artificial protection. Choose the best lie of the land there is, and put up some sort of artificial hedge to filter the wind and reduce its speed. Sheep-hurdles or horizontal boards nailed to uprights with a small gap between each two boards are good, but very expensive. A cheaper hedge can be made with more labour by driving two rows of rough stakes into the ground and filling between them with tree-loppings, bundles of straw, or any sizeable rubbish which can be added to from time to time as it sinks down. This artificial hedge can even be used as a nursery for a real hedge which gradually takes its place.

Fortunately it generally happens that the best place for hives is the bit of the garden which is least use for

anything else, but shelter cannot be the only consideration, because you have to try to avoid getting the flight lines of the bees straight across paths or other places where they will be a nuisance. I find it pays me to bring in some of my bees from their summer sites to winter in sheltered places near home, but such a move is not possible in a garden, except to achieve a permanent change of site. If you have fixed up a better place for your bees you can, of course, edge them there a foot or two at a time during the flying season, but it is often more satisfactory to wait until the bees have been confined to their hives for five or six days by cold weather in early winter and then gently move the hive to the new site. If any go back to the old site on the next warm day it will be very few.

RELIABLE QUEENS

It pays to replace all second-year queens before winter. They cannot be relied on during the winter, and if they do survive they are likely to give trouble in the spring before a replacement can be reared. If old queens have not been displaced during the main season and there are no young queens coming along in nuclei to replace them later, the stocks can be made to rear their own new queens. It is not wise to do this if you have any complaint against the queen other than her age; but if there are several stocks needing new queens there is probably at least one whose queen can be treated as a breeding queen. Remove the queen from the selected stock about 15 July, when it is too late for the resulting queen cells to cause a swarm. About nine days later make sure there are enough good queen-cells to provide for all the stocks that need re-queening, and then remove the queens from these stocks. The following day (or at least before the queens can emerge) one cell is grafted into each stock. At this season all other cells can be disregarded. The grafting is quite

simple, but needs care. Each cell is cut out with a sharp pocket-knife in a square of comb about 1½ inches across. The bees should be cleared away with smoke, and not by shaking, and the cell should be handled by the bit of comb, for the white queen inside is as soft as butter. If two cells are so close together that they cannot be separated without damage, treat them as one. If one of the wires of the frame interferes with your cut, use another cell, or saw slowly through it with a very sharp blade. Find a frame in the receiving hive which has a faulty patch of comb well within the brood-nest, cut out a corresponding square and put the queen-cell in it. If the fit is not tight secure the two combs together with a twig or a small nail. By 20 August the new queens should be laying, and you must make sure that they are.

At first sight it would seem that this manipulation does away with the autumn brood and makes the stock weaker for winter. It is a kind of artificial supersedure, but since we cannot make the stock accept the cell while the old queen is living, there has to be this long period without eggs. If the old queens had been left in they would have laid well until the end of July, and then at a rapidly falling rate until about 20 August. The new queens start laying about 15 August and lay until about 15 September. With steady feeding they will lay more and longer; they can be made to lay until the middle of October. But even without feeding they will just about make up for the lost eggs if there is plenty of food in the hive, and the resulting bees will be a month younger, and so all the better in the spring.

YOUNG BEES

Every stock of normal strength which has had a laying queen all the time or been re-queened early enough to get a month's good laying should have enough young bees

for the winter. A strong stock is needed, but there is no point in going beyond that. There is for any time of year a standard of strength to which healthy stocks tend always to approximate, and in tending towards it weaker stocks will carry, if they can, more brood than is usual for the season and stronger stocks will carry only the usual amount. A stock which is very strong in autumn will not necessarily have more brood the following March than a stock which is merely strong. But stocks which for some reason have not had a normal brood-nest in July may need some stimulation to help them to develop enough young bees, or a gift of brood from some stock that can spare it. Personally I am against autumn equalization unless the stock which loses the brood is deliberately fed to make it replace its loss. A stock may be very strong, but if you take one of its three brood-frames in the middle of August, you have taken a third of the early spring nurses. On the other hand, a strong stock with a young queen can lose all five of its brood-frames at the beginning of August and suffer practically no loss if it is steadily fed for four weeks afterwards. But only queens which start to lay in July and August can be relied on for substantial out-of-season brood nests in autumn.

Naturally the commonest reason for autumn stimulation is that the stock is a new one, building up from a nucleus, or from a small late swarm, which has not strength enough to stand the winter. It is often said that a nucleus must have two frames of brood and two of honey at the end of July if it is to survive, but that, in my experience, is not good enough. If the queen is old and the weather wet there may be no brood to follow. But if it still has two good frames of brood in early September, it will do. At this time of year it is not a case of one generation replacing another all the time; the generations pile on top of each other, and all have a good chance of surviving

long enough to get things going in the spring. These small nuclei, which have a brood-nest much below standard in early August, can, with stimulation, have one much above standard in early September, when normal stocks have practically none. There is never any shortage of pollen at this time, and the weather is mild.

If something goes wrong with a stock which is being re-queened late, and the queen is lost or does not mate, it may be possible for it to rear another queen and get her mated in September, but by the time she is mated it will be too late (and perhaps the stock will be too weak) to make a proper brood-nest. The stock can be united with another when you have made quite certain that there is no virgin queen in it, or, if you want to keep it and really have the strength to spare from other hives which are being fed, you may be able to give it a frame of young brood to rear each week until the second queen takes over and completes the brood-nest. But it is very hard to take brood from stocks when it is getting late, for it goes against the grain with them to start work on a new frame to replace the loss. When stocks are strong, brood spreading, so risky in the spring, can be useful sometimes in the autumn, for it is not now a shortage of bees but simply a lack of enthusiasm which holds back development.

This autumn stimulation is all in the nature of forcing, and is quite unnecessary in ordinary conservative beekeeping. It amounts to an exchange of sugar for young bees by which you can winter stocks which otherwise you cannot, and is useful when a substantial amount of increase is wanted without dividing the stocks during the main season. Whenever I do it I am reminded of the saying which beekeepers made when they used to go around 'driving' the bees from condemned skeps to save their lives and make new stocks of them: 'A pound of September bees is worth five pounds of July bees.'

FOOD FOR THE WINTER

The amount of food which is necessary to carry a strong stock through until it finds enough income in a normal spring is about 50 lb., which means that if the bees are on eleven British frames there is only just room for the food and a little space for the bees to cluster at the bottom of the middle frames. But if the food has only to last until they can be fed again in early April, 30 lb. is enough. Modern practice tends towards wintering with a large reserve and using spring feeding merely to counter bad weather at the end of the building-up period, but modern

12. *Normal position of winter cluster in early winter.*

sugar rationing makes it difficult to get the colonies heavy enough. Some people winter in double brood-chambers or one brood-chamber and a super, which means that the food is spread over a larger area. I have never been able to find either advantage or disadvantage in this, except that the large area of comb persuades you to leave more food, but I very much dislike seeing about 30 lb. of food scattered through twenty frames or more. By all means have plenty of space to hold plenty of food, but always aim at that compactness of storage which the bees achieve for themselves if they are fed in the autumn. One of the troubles of Heather-honey production is the determination with which the bees pack the stuff around the shrinking brood-nest.

This compactness, which is desirable for a strong stock,

is essential for a small stock, or the bees may starve when food is only an inch or two away from them. The normal behaviour of the cluster is that it moves slowly upward, consuming food as it goes from all the frames which it covers. Occasionally, if it is very mild, bees will leave the cluster and bring in some food from the outlying frames, but there is not much of this until the first spring days. If the bees reach the top of the frames in cold weather or come to the bottom bars of another set of frames and find no honey immediately above them, there may be a disaster. Since there is no food left in the centre frames, the cluster must move to one side – and it does not always choose the side which has most food. It may use up this food and be unable to get back to the other side. Sometimes it splits temporarily into two clusters, and one of them may die. Sometimes, especially if a quilt prevents them from passing over the top bars, you may find a section of starved bees sandwiched between two sections of living bees. These are accidents which happen only if cold weather catches the stock at an unfortunate moment, but they do not happen if an arch of food remains right over the cluster until the risk of really cold weather is over.

Small stocks winter on less food than strong stocks, and indeed it is not wise to make them store too much syrup, for the storage, though less exhausting than a honey-flow, needs energy and shortens the lives of the bees. For an ordinary nucleus, which was breeding in three frames in August, five British frames nearly full of food will do. Four- and even three-frame nuclei, if they are slowly fed almost to the limit, will rarely die of shortage, because these small stocks will not often develop much of a brood-nest before March, and it is not the winter cluster but the spring brood which consumes the food. A three-frame nucleus, fully fed, holds perhaps 13 lb. of food; in March

you are quite likely to find the brood-nest just started and 10 lb. of food still left. Naturally these little stocks, which have small reserve for building up, need prompt attention in the spring. Their greatest difficulty is in keeping a proper brood-nest warm in March. If cold weather then makes them lose some of their early brood, they may dwindle. Two or more nuclei in one hive, with only thin partitions between them, help to keep each other comfortable. Being short of material once, I separated some with sheets of metal, and was surprised to see how well they did in spring, with brood-nests on each side of the heat-conducting partition, almost as though they were halves of a single nest.

TIME OF FEEDING

Little stocks will usually put aside their stores gradually, and the stimulative feeding will be calculated to stop when there are both enough bees and enough food, but in the case of a normal strong stock you want to avoid having much of the winter food turned into bees, which will happen if the food is given while the queen is still actively laying. When there is an August honey-flow the brood which is reared is necessary to replace the bees which are used up in the fields, and must be reckoned as a cost of the flow, but it is unprofitable to let this toll be taken from a meagre ration of sugar. If the food is given quickly about the middle of September, the queen will probably lay only a few eggs, and she may not lay at all. In exceptional cases stimulative feeding can be carried on until the middle of October, but this is justified only where a queen has mated very late, and even a newly mated queen lays very reluctantly in October. If the syrup is offered in such a way that a large number of bees can take it at one time, a strong stock will store from 5 to 10 lb. a day.

When it is not intended to fill all the frames with food it

is as well to pick out frames which contain a good deal of unsealed pollen and put them back in a position where you can be sure that the pollen will be topped up with syrup and sealed over. This pollen can be extremely useful in the spring, but if it is not protected it is liable to mildew. Apart from the waste, the bees find it almost impossible to remove the hard residue of mouldy pollen. They literally have to chew the comb away to get it out.

HONEY OR SUGAR?

There are those who argue that bees should never be fed on sugar, because it is an unnatural food and undermines their constitutions. I can only say I have never noticed it, and that if it is true, it is true only over a very long period. On the other hand, some of the things which bees will collect quite naturally, such as the sweet excretions of sap-sucking aphids, can be harmful even in quite a mild winter. Whatever may be the test of a good food for the brood, for the winter cluster the test seems to be purity, for only a food which contains practically nothing indigestible can save the bees from becoming congested when a long spell of cold weather both makes them consume more food and prevents them flying to cleanse themselves. By this test the honeydew of aphids is always bad, Heather honey none too good, and sugar syrup is slightly better than the purest honey. It does not matter whether the sugar comes from cane or beet, so long as it is refined to whiteness. Heather honey contains more pollen than other honeys, but complaints of its quality as a winter food come mainly from Scotland, where the cold spells are apt to be longer than in the South. Even so, I would not winter a nucleus on Heather honey only, because the smaller the colony the more food each bee may have to consume to hold the temperature, and it is a common practice to feed a little syrup to stocks when they come

back from the Heather, even if they have plenty of food without it.

American beekeepers often save a shallow frame super of honey to use as a 'foodchamber', and so avoid feeding in the autumn, and this is no doubt an excellent practice, but we must remember that it became common when their honey was worth fivepence a pound and sugar syrup was worth half as much. They argued that by the time they had extracted the honey and given themselves and the bees the trouble of getting the syrup made and sealed, they might just as well have left the honey. But in Britain honey is usually at least four times the price of sugar, and our common practice is to leave such honey as there is in the brood-chamber and make up the weight with syrup, adding perhaps a frame or two of honey if it is very short. This compromise seems to work quite well, and allows the bees at least a proportion of honey for the early spring brood-nest. There is not at present any real evidence that syrup is inferior as a food for the larvae, and in any case the bulk of the bees are bound to be reared on honey, because the nurse-bees use what comes in from day to day during the gathering season.

CLOSING DOWN

In the final closing down there are three things to provide: a bee space over the frames, plenty of ventilation, and a mouse-proof entrance. If a crown board is used, there is a space over the frames already, but quilts must be lifted to provide a passage-way so as to reduce the risk of bees being caught between two empty frames. A simple way of doing this is to lay two sticks about an inch apart across the top of the frames, or to support a bit of thin board so that the bees can walk under it. Provided the quilt is made of canvas (the sort that farmers use for covering stacks or machinery) this slight extra job is the

only disadvantage that I know of in using quilts instead of crown boards. No extra packing on top is necessary, but if you want to use some, make sure that it does not stop all ventilation and collect damp.

W.B.C. hives always have roof ventilators, but some modern hives do not. In that case it pays to put a bit of stick or slate under the roof at one side so that just a little damp air can drift from the open feed-hole in the crown board or quilt and escape. Some like a small top entrance through the wall of the hive at the top. The bees certainly like it, and use it freely. If the wood of the roof sides is at all porous it must be waterproofed with bitumen or something similar, or damp will creep up inside the wood.

The entrance can be mouse-proofed either by fixing over it some finely meshed wire or, more simply, by using an entrance block with an opening nearly as long as the hive is wide, but only ¼ inch high. Mice will often nibble at the edges of this entrance but I have never known one get past, so long as the wood is sound. It is worth making quite sure of it, because if they do get in they may starve the colony by eating away all the outlying food. The life of the hive will be much longer if you make sure that no part of it is kept continually sodden, as may happen if it is under the drip of a tree or in a place where there is no movement of air. The modern legless hives, which usually rest on two bars of wood supported a little way above the ground, may be damaged if the bars have begun to perish and hold too much moisture.

MODEL CENTRE FOR VILLAGE INDUSTRIES, T. KALLUPATTI, MADURAI DT. 2 - JAN 1958

PART III

ETCETERA

Chapter X

INCREASE

In the second part of this book I have tried to keep, as far as I could, to the main story of managing bees through the season, limiting the 'asides' to avoid confusion. In this last part I must now pick up a number of things which have been left out or mentioned only casually.

The more we inhibit natural increase by controlling swarms, the more we need artificial increase to take its place. The commercial beekeeper has to make up stocks artificially, if for no other reason than that he has to plan his work and his numbers, and swarming is too uncertain; but even those who depend entirely on natural swarms can often make good use of one or two nucleus stocks for mating queens, because the mating of a queen in a large stock (except in August) is bound to involve a heavy loss of brood, and if it is not successful it may even jeopardize the survival of the stock.

Apart from artificial swarms (page 111), we really depend on nucleus stocks, which can either be used to provide the queens which are needed for larger divisions, or can themselves be built up into full-sized stocks. The main difficulty lies in getting these nuclei established without their being deserted by their bees or robbed out by other bees. To take a frame or two of brood and some bees and put them in a hive is nearly always just a waste of bees; the only hope of such a stock surviving is that there should be a strong honey-flow, so that no bees have any interest in robbing it, and warm weather to help the handful of young bees that will remain in it to mature the sealed brood. Even so the eggs and larvae will be lost.

NUCLEUS WITH A QUEEN

A queenless nucleus becomes disorganized, so that not only the field-bees go back to the parent stock; every bee that is more than three days old and has ever flown at all will go back, and even some of those younger may crawl out and try to get away. But a nucleus which contains the queen, although it will lose all its field-bees, does not become disorganized. It may lose a few more bees after the field-bees have gone, because those of the younger bees which take a flight during the first day or two may go back to the parent stock, but they do not desert in a body. So this kind of nucleus, if it starts with plenty of bees so that it will still be well enough populated after it has lost a half or two-thirds, and if it can be protected from robbers, usually succeeds. For a week or ten days it has hardly any flying-bees, and its combs must contain pollen as well as honey. Robbery is best avoided by not doing the job in that clear, cool weather which leaves the field-bees idle and inquisitive, by having an entrance which is only ½ by ¼ inch, and by doing nothing in the making of the nucleus that might attract strange bees, such as spilling a drop or two of honey or exposing the frames near the site of the new hive. If you have to feed the nucleus, try to avoid doing it until it has flying-bees and entrance guards again.

QUEENLESS NUCLEUS

In the early part of the season a queen-right nucleus is more or less out of the question, because a queen cannot be taken from one of the strong stocks without destroying its profit. But later there may be failing queens, or queens which are discarded as a measure of swarm control. Making a nucleus is a useful last job for a failing queen; she can be taken out as soon as the stock is established.

Sometimes you may be lucky enough to find a supersedure cell in the nucleus when you go to take out the old queen, and when that happens you can simply exchange the cell for your selected one, and leave the old queen to help the nucleus along.

But early in the season, when nuclei may be needed for queen replacement or swarm control, they have to be queenless. The simplest thing to do is to make up the nucleus without any surplus of bees – since there will be no loss, a surplus is not needed. Shut the hive up at once, and move it two or three miles away, and leave it there for five or six days before you bring it home. An alternative is to put it in a dark cellar for three or four days, but this is not so good, because some of the bees may return to the parent hive, and they lose several days' work while they are shut in. It is worse still if they are shut in out of doors, because they will waste a great deal of effort in trying to get out, but nevertheless they are better shut in so than not at all.

If you have one strong stock which is to be divided into four nuclei (and that is about as far as you can go), and you do not wish to transport the new stocks, here are two suggestions:

1. Make up a hive so that it can be divided into three hives, each with its own separate entrance. The division boards must, of course, slide in and out and fit flush to the floor and walls, and there must be some efficient means of preventing the bees from passing under or over the quilts – three separate canvas quilts each nailed down at one side and slightly overlapping serve the purpose. Put the stock into this hive on its original stand, but without the division boards. At first the bees will use only the entrance on the side they are used to, but within a week or two they will use all three entrances. As soon as the hive is getting crowded and has about eight frames of brood, take off a

small nucleus with the queen and put it on a new stand, aiming to get about a quarter of the bees to stay there. A day or two later, when the main stock has realized that it is queenless, put in the division boards. Each of the three stocks will keep the flying-bees that use its entrance, so give the best brood-frames to the division with the fewest flying-bees. If you decide to divide only into three, without first removing the queen, there is a little risk that too many bees will find which division the queen is in and that this stock will rob out the two weaker divisions, so anticipate this risk as much as you can.

2. To achieve the same result without a divided hive, take off the nucleus with the queen as before. Wait a day or two until queen-cells are well started, then remove the main stock to a new stand. Put in its place two hives close together with their entrances at an equal distance on either side of the old entrance, and put in each a very small nucleus from the main stock, just one frame of brood and one of honey. The reason for making them so small at first is that the main stock has been moved away, queenless. If it is immediately reduced to three frames it may be deserted, but if it is left fairly strong for a day or two and there is a queen-cell or two building it will hold enough bees. The two stocks on the original stand need to be watched and balanced; if one begins to get the upper hand it must be moved away a little and the other moved in until they have about the same strength. As soon as the three queenless divisions have settled down they can be equalized by re-distributing the brood, which by now will all be sealed, so that nurse-bees do not have to be considered. If it is intended that the new stocks should get queens from their own queen-cells it is wise not to make the division until the cells are sealed, because they may not be well enough fed by the small, unbalanced stocks.

There is one other trick that I should mention. If you

want to take off a nucleus from a stock, perhaps with the intention of reuniting them when the nucleus has a laying queen, you can attach a few flying-bees to it by first making a small back entrance to the main hive by putting a wedge between floor-board and brood-chamber or between brood-chamber and super. After about a week, when some bees are using this entrance, close it and put the nucleus hive straight behind where it was, with its entrance facing as it faced. (Bees are always more easily tricked into using a new entrance in front of their old one than a new one at the side; an empty hive put in front of their entrance and as much as a yard away will muddle them properly for an hour or two, while at the side it will be totally disregarded.)

Nucleus stocks which are used only for rearing queens can be joined together at the end of the season. Here again the hive with sliding divisions is very useful. But those which are intended to be wintered as separate stocks must have built up well before the end of July, or they must be stimulated through August. It is quite possible to divide a good stock into three at the end of July and to winter all three divisions successfully – possible, but it is not prudent, nor is it usually necessary to try it. Dividing into two is usually safe enough if the new queen-cells are started about 20 July and the actual division is made at the end of the month. If two stocks are to be divided it may pay to divide one into three and use the other to provide (with some stimulation) the extra brood they will need.

SELECTED QUEEN-CELLS

In Chapter VI (page 106) I suggested a way in which the small beekeeper might raise a few queens with a reasonable certainty that both parents are known. But the method is so hedged about with conditions that he will

usually have to be content to select his bees on the female side only. At first sight this seems very unsatisfactory, but in fact good progress can be made in improving the strain, provided you make sure there are no drones flying which come from really poor queens. You cannot have all your queens of first quality, but at least you can make sure that third-quality queens are not allowed to produce drones.

Good queen-cells are made only in stocks which have more nurse-bees than the brood-nest needs. This is always the case with stocks that are preparing to swarm, but cells from these stocks are not the ones you want if you are trying to breed away from swarming. When they happen to be there at a time when nuclei need cells they are a great temptation, and one which need not always be resisted if the stock is otherwise good and is swarming mainly because of the age of the queen. An odd cell may be picked up now and again when a good queen is being superseded, but mostly they have to be got artificially, which means that they must be reared in batches if it is to be done economically, and that they must be started ten days before they are needed. The simplest way to do it is to remove the queen from a suitable stock and leave it to rear cells, but in the early part of the season, when every egg counts, this may be an expensive thing to do, especially since non-swarming strains are reluctant to make cells. If a strong stock is without its queen for as little as ten days in May that may be enough to make the difference between a crop and no crop in a poor season.

The professional queen-rearer makes up special stocks and rears in them a large batch of queens at one time, transferring baby larvae into rows of artificial queen-cell cups. He even has one stock with the right balance of bees for starting the cells and another to feed the growing larvae, so that the batch of cells is moved on every two or

three days. But these things are not for the amateur, who usually only wants three or four cells and wants to get them at the least cost in honey.

For rearing a large batch of cells a very strong stock is needed, but four or five can be got from a medium stock and two or three from a strong nucleus – *provided that the nurse-bees can concentrate their efforts on the queen-cells*. That is to say, unless the stock is very much stronger than it needs to be to maintain its brood-nest, the building of queen-cells should not start until three days after the queen has been removed. If you have an indifferent stock which looks as though it will not build up in time to give much surplus, that will serve very well. It is most unlikely that such a stock will be the one you wish to breed from, so you will have to introduce the brood of your selected queen at the right time, and make sure that the queen-cells are built on this brood. Here are three suggestions:

1. Remove the queen. Six days later (when the youngest remaining larva will be beyond the proper age for rearing as a queen) destroy all queen-cells and exchange one frame of brood (without bees) for a frame from the chosen queen. Pick a frame with plenty of eggs and very young brood, with as new a comb as possible. The bees find it difficult to base their queen-cells in comb which is made tough by old pupa-cases.

2. Three days after removing the queen destroy the cells that have been started and give a frame specially prepared for the purpose. This frame, containing only a strip of foundation, is put in the middle of the selected queen's brood nest about a week before. When it is transferred the comb is cut back to a line where the eggs have just hatched. The combination of soft new comb and larvae of just the right age is so attractive that the bees will probably not start any cells on the other combs, but it is as well to make sure. To get the largest number of

cells, all far enough apart to separate them with a knife, it is wise to abolish most of the larvae in the bottom three rows of cells, leaving a few just over an inch apart. With this attractive material the stock may try to rear more cells than it can do really well, so limit them to the number you need with one or two spares for safety. If the stock is really strong and a large number of cells is wanted, the special frame can be differently prepared. Give it a full sheet of foundation, strongly and tightly wired, and try to get one side well filled with eggs. As they begin to hatch reduce them more or less to the number required, keeping the potential queen-cells away from the wires, and lay it on its side on supports about an inch thick above the frames of the cell-building stock. This leaves the larvae hanging down in the same way as they do in swarm queen-cells, which usually start from eggs laid in the little hanging cups which the bees like to prepare in advance in uneven places and corners and on the edges of the comb. This method comes as near to large-scale production of queen-cells as you can get without the rather tricky technique of transferring larvae into artificial cups.

3. If you are in a hurry, shake or bump the bees off all the brood-frames after you have removed the queen and exchange them for a smaller amount of brood from the selected stock. Do not give too many eggs and young larvae, or you will overload the nurse-bees.

There are other ways of getting queen-cells reared, but the first principle is always the same; the stock must be strong for its size and in a condition which puts no strain on the nurse-bees. If the queen is simply removed from a selected stock, it often pays, during the building-up period, to destroy the cells which the bees start during the first three days. Sometimes the stock will take this precaution for itself, and not start more than one or two cells until there are no more eggs to hatch. It is possible, in the

earlier part of the season, to get queen-cells made in the top storey of a queen-right hive so long as it is separated from the main brood-nest by several supers, but there are risks in this – risks of causing a swarm, of not getting the cells at all, or of having insufficient strength in that part of the hive for the development of good cells. A stock of this sort, which is strong enough to make two brood-nests, can just as well be temporarily divided, or it can provide a few frames of brood to build up a queenless nucleus until it is strong enough to rear good cells. A swarm, during the first week or so after it has come off, has the right balance of bees to build good cells, and so has a swarmed stock a few days after the swarm has gone.

A good cell is not to be judged by size – very large blunt ones not infrequently contain a drone, for bees are strangely foolish about the sex of larvae. They will always try to make queens from male larvae if they have no other, and they will sometimes pick on a male when they have plenty of females. The stubby, short cells which result when a larva is switched from worker to queen on the second or third day after hatching should always be avoided, and the very long, thin cells in which the larva seems to have slipped down are probably not of the best. I have not noticed that the 'emergency' cells which curve out and down from the face of the comb are necessarily inferior to the 'swarm' type which are built straight downwards from the bottom of the comb or from a queen-cell cup, provided that they are started around an egg or a larva only a few hours old. Some say these cells are always started too late, but it is quite common to see the surrounding cells destroyed and a cup built round an egg on the face of the comb; but there is perhaps more chance of an unsatisfactory cell in this position. If you want to try your hand at transferring larvae without risking anything, it is good practice to get a transferring (grafting)

needle and put a very young larva in any natural queen-cell cups there are in the hive. If the larvae do not stick, use a spot of the royal jelly from a developed queen-cell or a spot of larval food to hold them to the base. If they all fail, the bees will develop other cells on the frame provided for them, but if they succeed, they may increase the number of good cells reared.

Different strains of bee vary greatly in the amount of wax they use in the walls of queen-cells, and this is of no importance except that the thin-walled cells are more liable to damage when they are handled. In fact, apart from throwing out stunted and misshapen cells, there is not much selection you can do once they are sealed, but if you pay attention to them when they are being started you can see to it that no afterthoughts are allowed after the selected frame has been four days in the hive. The nucleus which receives the cell should have been queenless for forty-eight hours, or at least for twenty-four, or the cell may be destroyed because the stock has not yet realized that it is queenless. If you see the beginnings of queen-cells after twenty-four hours it is safe to graft the cell into the comb. If the nuclei are ready, the cells can, of course, be distributed as soon as they are sealed, but in any case it is as well to plan to do this not later than the tenth day, which leaves one day to spare if bad weather postpones the job. Queens vary a little in their time of emergence (the earlier they are the lighter is their colour); the sixteenth day is usual, but it is not worth risking one coming out on the fifteenth day and destroying the others.

Artificial increase is an exacting business. Accurate records are vital, and until you have that sense of what is and what is not possible there are bound to be some failures. You can by artificial means increase the number of your stocks much faster than you can by waiting for

swarms, but it is very easy to go too fast. If you are prepared to feed slowly in the autumn you can take a crop of honey from a stock and divide it into two at the end of the honey season, or you can sacrifice the honey and make a good stock into three or even four, but to go beyond this is asking for trouble, and even this means wintering your stocks at a strength which is below the ideal in a very hard winter.

Chapter XI

PLAGUES, PESTS, AND NUISANCES

For two reasons this is not the place for any long discussion of the diseases of bees. A beekeeper, however long his experience and however large his scale, does not, unless he is uncommonly unlucky, get the opportunity of observing all the various ailments at first hand, and secondly, accurate diagnosis is a job for an expert. The ordinary beekeeper needs to know only what sort of thing should make him send a postcard to the Beekeeping Officer of his County Agricultural Committee, and it is from this point of view that this chapter is written. The Beekeeping Officer is not likely to wait long before he examines a suspected stock, for a large part of his job is to reduce disease in his area, so he will do all he can to prevent disease spreading either among your other stocks or into your neighbour's apiaries. He in his turn can call on the scientists of the National Agricultural Advisory Service if he has any doubt what the trouble is. He certainly will not blame you if you have called him to look at some minor trouble. He will probably tell you that if everybody called him as promptly he would have less work to do and fewer people would suffer the disappointment of losing their bees by disease.

Only a few years ago it seemed as if all serious bee diseases were under control – still capable of causing loss, even heavy loss, to those who did not examine their bees regularly, but no longer a menace to the conscientious beekeeper. Since then an old disease, European Foulbrood (if indeed it was correctly diagnosed in past years), has shown a new and very ugly face. Fortunately it is limited to certain districts, and does not at present show signs of sweeping across the country with the wholesale

destruction of Acarine (Isle of Wight) disease in the second decade of this century. The other serious diseases are Acarine, which is a disease of the adult bees, and American Foulbrood, which is a commoner disease of the brood, quite distinct from European Foulbrood.

Acarine is an endemic disease. It is found in a fair proportion of apparently healthy stocks all over the country, and although it can be fatal when it gets the upper hand, it is not difficult to control. American Foulbrood is a disease of such violent infecting power that the germ can wait many years for its victim, and can be destroyed only by burning. Fortunately, however, it does not spread very fast from stock to stock if it is quickly diagnosed and dealt with, but if a stock is allowed to die of it every healthy stock in the neighbourhood is liable to take the disease home with the honey which it steals when the diseased stock is past defending its stores. European Foulbrood is not necessarily a fatal disease if it is allowed to take its course; it kills a proportion of the brood in the early summer months, and so weakens the stock that it is uneconomic. It does not always show up quickly in a stock which has caught the infection – in fact I have heard of a case where it took several years to show its typical symptoms in a stock which had been deliberately infected. Probably because the infection is there before the beekeeper has reason to expect it, it has wiped out large commercial apiaries in Southern England during the last few years, and become perhaps our worst menace.

ACARINE DISEASE

During the first decade of this century Acarine disease appeared in the Isle of Wight. It destroyed all the bees there, and during the next two decades it spread all over the country, wiping out perhaps half of all the stocks.

The evident symptom is a large number of bees crawling

about in a half-dead state in front of the entrance, climbing up stems and stones and trying unsuccessfully to take flight. Some of them have their wings out of their proper position, as though they were dislocated, and some have their bellies distended. This symptom is in itself no proof of Acarine disease: it is a symptom of distress which may be caused by other diseases, by poisons, or anything which causes slow death; but Acarine is the commonest cause of it, and should always be suspected when it is seen. In a bad case the stock quickly fades away.

In their hunt for germs, investigators missed a comparatively large parasite, and it was not until 1921 that it was shown that the disease was caused by a mite which lives and breeds in the breathing tubes of the bee, gradually stifling it by the congestion and the damage which it causes. The mite is able to enter only very young bees, up to five or at most ten days old, so that it is the older bees, which have been long infested, that show the disease badly; but the young bees, which show no obvious symptoms, are being infested all the time.

When the disease had passed through any district some colonies survived, and most of the stocks in the country now carry in them some blood of these resistant strains. The very slowness with which the cause was found and a treatment worked out must in itself have contributed towards the development of resistance. So when there is an outbreak now it is usually a much less disastrous affair than it was, and Acarine seems now to have settled down among our native bees into an endemic disease like tuberculosis in human beings, present in a small way in most stocks, or never very far away in their heredity, flaring up occasionally into serious and even fatal cases; and that is probably the state of affairs which existed in those parts of Europe from which it came to us. But in bees imported from countries which do not know the disease (and that

applies to the whole of America) you would expect the same virulent attack as our own bees experienced at first.

Some people like to have a test made every year to make sure the disease is not latent in their stocks, and this is no doubt a good practice; but I think it is unwise to be too fussy, and to try to stamp the disease out altogether, because you can be sure your neighbour will not do so, and bees which never experience the mite may lose their resistance and lay themselves open to a bad attack later on.

There are two treatments in vogue, both of them given by fumigation. The Frow treatment, which is sold with complete instructions, is a drastic treatment, and can be given safely only when robbing is unlikely; that is to say, it must be winter-time, or there must be a strong honey-flow, or the stock must be confined (with all the troubles that that brings). The smell of the vapour makes the bees unable to recognize robbers or else too lethargic to repel them, and the robbers come to associate the smell with easy gains. The Frow treatment should be followed by the preventive treatment, and this alone is effective except in very bad cases. It is to keep a little of the vapour of synthetic oil of Wintergreen (methyl salicylate) in the hive all the time, by letting it evaporate from a wick passed through the cork of a small bottle or test-tube or from some sort of vaporizing pad. It seems that the mite, when it leaves its moribund victim and seeks a new host, hunts the young bees by smell, and the vapour of Wintergreen confuses it. It does not, like the Frow treatment, attract robbers, and even bad cases may be cured in time, although it will not save the bees which are already infested.

During the winter and early spring there is another symptom which may be the result of Acarine. When the bees are so congested in their bowels that they cannot fly to cleanse themselves, but mess up the entrance of the

hive and the flight-board, it may be simply that the colony is weak and that they have had to consume more food than is good for them to keep up the temperature during a long confinement, but if the stock is strong, Acarine is to be suspected where this so-called dysentery occurs. The mites can make the bees restless, and they eat more when the cluster is unsettled. Some of them winter outside the bee, at the base of the wings, which is perhaps the position from which they transfer themselves to a young bee in the spring. When Acarine is about or is suspected the safest thing to do is to give regular treatment with oil of Wintergreen; it will nearly always prevent serious outbreaks.

Personally, I have not found it necessary to use either treatment since I took to creosoting the insides of the hives every second year, because the creosote appears to act in the same way as oil of Wintergreen. I have had only two obvious cases, which both happened in hives which had in some way escaped creosoting, and both of them were cured by giving freshly creosoted hives; but creosote is every bit as bad as the Frow mixture in attracting robbers to the hive, and I certainly would not recommend my method except experimentally, both because I have not used it long enough to prove anything, and because of the disasters it can lead to in inexperienced hands. But it does seem that Wintergreen is not the only smell which will upset the mite.

So first send a few of the bees which are crawling about outside for examination, to make sure whether Acarine is the trouble, and start Wintergreen right away, because it is harmless anyhow. You can later decide whether the Frow treatment is necessary and whether it is worth while to risk robbing to save some of the infected bees. Acarine is the disease you can *expect*; if the others come, you have had bad luck. If a stock dies of Acarine, the

mites die with the bees, and the combs can be used for other stocks without any sort of precaution.

BROOD DISEASES

When anything is found wrong with the brood, there is one urgent and vital question to be answered: 'Is this Foulbrood?' It is the duty of every beekeeper, both to himself and his neighbour, to have any faulty brood examined unless he is absolutely certain that the trouble is not serious. And I mean examined by a bacteriologist with a microscope, not by a beekeeping acquaintance who probes with a match-stick to see whether the dead bee is more or less glutinous in its decay. An experienced man will have a good idea whether one of the Foulbrood diseases is present, but there are many doubtful cases he will not presume to diagnose for certain without the help of the bacteriologist.

The two main diseases, European and American Foulbrood, are not by any means the only cause of the death of brood. There are at least three common causes which are of little importance and do not call for any drastic action. Sometimes, in spring or early summer, the bees (especially in a weak colony) are too optimistic, and make a brood-nest which is too large for them to keep warm in frosty or cool rainy weather, and some of the brood on the outside edge of the nest is chilled and dies. The same condition may be caused artificially by the beekeeper when he spreads the brood or divides the nest too early in an attempt to control swarming. This *Chilled Brood* is easily recognized, as also is *Chalk Brood*, a disease which may be slightly infectious, but which affects only certain strains of bee, and usually not the best strains. But *Addled Brood*, which is also far more common than either of the Foulbrood diseases, can easily be confused with American Foulbrood by anyone who has not seen both. It is usual to

add to the list *Sac Brood*, which is said to be practically unknown in Britain, though common in America. Since its symptoms (judged by American descriptions) are almost identical with those of Addled Brood, and since Addled Brood seems to be as rare in America as Sac Brood is here, it may well be that there is some connexion between them, even though Sac Brood is said to be mildly infectious while Addled Brood is not. In any case, all these are easily dealt with, and the only real problem is to distinguish between Addled Brood and American Foulbrood.

The following list of the brood diseases and their treatment may be helpful.

America Foulbrood. – The dead bees are mainly prepupae – that is, bees which have been sealed up in their cells but are still in the form of larvae, though they are at this stage straight and not curled. Quite a number die after they have taken the form of adult bees, and a few may die before they are sealed over, while they are still curled up. Some of the cappings over the dead brood are removed completely, showing the putrid remains, but mostly they are punctured, pitted, or sunken. The whole area of comb has a dark, greasy look. If a piece of grass stem is pushed into a number of cells, it can, in some cases, be withdrawn 2 inches or more before the saliva-like thread drawn from the remains snaps. This character is often called 'ropiness', and is sometimes taken to be the clearest indication of American Foulbrood, but it is not altogether reliable, and I would prefer the punctured and sunken cappings and the general greasy look as the best indication. But ropiness may be a help if only a very few cells are affected by the disease, so that it is difficult to get a general picture.

The germs which cause this disease have a revolting but interesting ability to become dormant when they are not actually consuming bee brood, and in this dormant or 'spore' condition they can wait literally many years for

their next meal. As the spores are scattered about in the honey and on the comb and woodwork, and even boiling them will not certainly kill them, very drastic methods are needed to prevent a spread of the infection. The first essential is to discover the disease quickly. It can be very wholesale in its destruction of the brood, and leave the infected colony too weak to defend itself after only a few weeks, when robber-bees will carry it all over the place. But if the bees are regularly inspected and all the infected material is destroyed before robbers have their chance, it is most unlikely that any other stock will catch the disease. Various drugs have been tried both for curing the disease and for cleansing the combs, but none of them has given safe enough results to allow of any alteration in the regulation which says that infected stocks must be burned.

If you suspect that you may have the disease in one of your stocks, don't quietly do away with it. You may not do the job well enough without advice, and you will certainly lose the compensation which your beekeepers' association will otherwise pay you. Inform the Beekeeping Officer of your County Agricultural Committee who will have your suspicions confirmed or denied. If it is the worst, he will advise you how to kill the bees after sunset with petrol or cyanide, keeping the hive tightly closed so that none can escape, and he will watch you with a sympathetic eye while you dig a pit, light a large fire in it, place the hive beside it, carefully burn and finally bury the bees, the frames and the sweepings of the hive. The inner woodwork of the hive itself must be toasted to a light-brown colour with a blow lamp to make it safe for another stock.

A.F.B. is not carried by drifting bees or by swarms. It is nearly always spread by the beekeeper moving an infected frame from one hive to another, perhaps hiving a

swarm on infected frames, or in a more wholesale way by healthy bees robbing the infected food from a moribund stock.

Where the standard of beekeeping is high enough to make sure that these things do not happen, the disease may nearly always be cured by patiently feeding one of the sulpha drugs, commonly sulphathiazole. This drug can be obtained in a water-soluble form, prepared for the treatment of chickens. It is added to sugar syrup at the rate of ½ gram of sulphathiazole to a gallon of syrup, and fed to the bees in the ordinary way. It quickly reduces the disease to one or two cells only in the majority of cases, and sometimes all evidence of the disease disappears. But the infection remains latent in the hive for a long time in the stored honey, in scales left in outlying combs, and perhaps even in fragments of scale left buried in the comb under new pupa cases. For the bees have the greatest difficulty in getting away the whole of the scale. It will not come away all in one piece, and I have several times seen healthy larvae growing and maturing under the influence of the drug in cells which had an obvious fragment of scale in the bottom.

Nevertheless, *persistent* dosing in spring and autumn for perhaps a couple of years will whittle the infection down to nothing in almost every case, for it seems that a *very small* number of the germs, fed to a larva, cannot restart the disease. Because the cure is neither quick nor positive, and the treated stock continues to be a danger to other stocks, the Ministry of Agriculture do not allow this treatment to be applied when an infected stock is notified.

European Foulbrood. – While American Foulbrood may be found at any time of year when there is brood in the hive, European Foulbrood is mainly to be found in May, June, and July. In the late summer it becomes latent, and reappears the following spring. The means by which the

infection spreads are not known for certain, though it is probably carried by flying-bees, possibly by nurse-bees which 'drift' into the wrong hive when they return from one of their play-flights. It spreads through an apiary at a great rate. I have seen a case where only one stock was without evident symptoms of the disease in an apiary of thirty stocks, although only two years before there was no sign of the disease. And the owner did not realize that anything was seriously wrong until all his stocks were infected. As the infection is carried in the bee itself, it spreads from one apiary to another by swarms, and possibly also by robbing.

Because the disease is quite unchecked by the germ-killing sulpha drugs, there is some speculation whether it may not be basically caused by some virus, in spite of its association with Bacillus Pluton. If this should be so, there would seem to be little hope of progress against it except by breeding resistant strains of bee, as is done in the case of plants which suffer from virus diseases. But at the moment it remains to be seen whether there is any chance of stamping it out by destroying all infected stocks which can be found in the limited areas (mainly in Hampshire and Wiltshire) where it flourishes. Those responsible for this work will forgive me if I say that at present the issue is very doubtful.

There is a seasonal trouble which can easily be confused with E.F.B. It is often attributed to poisoning caused by too much buttercup pollen, because it always seems to come when there is little other pollen available, and disappears as soon as Hawthorn is fully out. It was very bad in my district this year (1950), worse than I can remember it for ten years. I must have seen it in a hundred hives in one week, some of them losing only about a dozen larvae and some of them many hundreds. The thing looks very like E.F.B., except that the dead larvae

are in arch-shaped rings on the comb – all more or less of one age-group, while in E.F.B. they are scattered all over the comb. If any die after they have been sealed they become black and watery. The trouble stops as quickly as it started, though it may take a week or so for the bees to clear up all the mess.

It is easy to see that E.F.B. is far less controllable than A.F.B., though fortunately it is at present far less common, and even vigilant beekeeping may not altogether prevent its spread. It has caused several major disasters in large apiaries in the last few years. There is no known treatment or cure; quick diagnosis is the only way of preventing widespread infection, and the law requires the stock to be burned and buried, as in American Foulbrood. One of the worst features of the disease is that the infection builds up slowly; for some time an infected stock may show only one or two dead larvae or none at all, but it is capable of infecting other stocks.

In American Foulbrood and Addled Brood the majority of the dead are prepupae, though there are often some pupae also: the distinguishing mark of European Foulbrood is that the majority of the dead are curled larvae. In the first two diseases the dead lie more or less evenly on the lower side wall of the cell; in European Foulbrood they are twisted about in odd and uneven positions. The 'scale' – the dark, dried-up remnant of the larva – is comparatively easy to remove; in fact many strains of bee which are good house-cleaners remove most of the dead larvae before any scale can form. In American Foulbrood it cannot be removed, once it has dried, without breaking the cell-wall.

Addled Brood. – Addled Brood and Chalk Brood are the commonest brood troubles, Chalk Brood being perhaps the commoner of the two. Both of them are simply treated by changing the queen, giving the stock, if

possible, a queen known to be of good strain and mated in another stock. Both diseases get a hold because some inherited fault or weakness allows them to do so, so a new queen who is the daughter of the old one would probably be just as bad, and a cell or virgin queen given to the stock would be likely to mate with a drone that carries the bad heredity. At first sight Addled Brood looks rather like American Foulbrood, except that it is less extensive. But the cappings over the dead prepupae are not sunken or punctured to any great extent. They are either intact or else removed, showing the dead prepupa (or sometimes pupa) lying straight in the cell, shrunken but *keeping its original shape*. In A.F.B. dead pupae remain just recognizable, but melted in decay, often with their tongues sticking to the upper wall of the cell, but prepupae flatten into pools on the bottom wall of the cell before they dry into a scale. Addled Brood produces no greasiness of the comb, and the dead larvae are not ropy. The bees are often slow to remove the dead, but the scale does not stick as tight as in A.F.B. The disease has a habit of wandering about the hive, affecting now one comb and now another.

The orthodox view is that the queen carries some lethal factor which makes some of her brood die. There is also the possibility that she produces inefficient nurse-bees or that her bees are unable to resist an infectious disease that most bees can resist.

Chalk Brood. – This is primarily caused by a mould. A proportion of the prepupae die and take the shape of the base of the cell. They look like little lumps of dirty chalk or some pollen that has gone mouldy in the cell. It is an infectious disease that most strains resist, though occasional larvae dead of Chalk Brood are found in many stocks. It never seems to be quite bad enough to destroy a stock, but in bad cases the constant loss of a proportion of the brood must be very weakening. It never calls for

drastic action which might leave the stock queenless for a period, but since stocks which tolerate Chalk Brood are rarely first-rate in other respects it is as well to requeen them as soon as a suitable queen is available. It is always worth while to wait the few days that may be necessary to get the queen mated in another stock, so as to make reasonably sure that the next generation of bees will not be descended from either the queen or the drone of the affected stock.

Chilled Brood. – The beekeeper can usually relate Chilled Brood either to a spell of very cold weather during the building-up period or to some ill-advised experiment of his own. The brood is white or greyish-white, and does not appear to be putrid, as in the Foulbroods and Addled Brood. Brood of all ages dies, and is quickly removed if the bees are strong in numbers. It cannot be confused with other troubles, because the dead brood is nearly all on the outer edges of the nest, and the trouble disappears when the weather changes or the brood-nest readjusts itself to the new shape which the beekeeper has imposed on it. There is sometimes a very conspicuous case when the stock is near starvation in late May or early June and cannot maintain its brood-rearing temperature. In such a case piles of dead brood may be thrown out at the entrance, and unless help is quickly given living brood will follow the dead.

NUISANCES

Of the general nuisances, two are sure to bother you at some time or another, and others may do so. Wasps and mice are always with us. Mice will not venture into the hive in summer, but must at all costs be kept out during the winter (page 163). Wasps can destroy weak stocks and damage strong ones in August, September, and October. It takes several bees to deal with a wasp, which is stronger

and more agile than they, so it can easily happen that other wasps will slip past when all the guards are embattled. Once they have got a little honey from a hive they are very artful and persistent. They work earlier and later in the day than the bees, and they work in any weather, gradually robbing the outside frames where there is least risk of being set upon by a large number of bees at one time. Attacked, they usually manage to get away, and the bees kill them only at a great loss to themselves. In a nucleus stock they may even kill all the older bees and have the stock completely at their mercy. It is not always easy to find all their nests, but those which can be found should be destroyed with cyanide or petrol; all stocks, and especially the weak ones, should have their entrances much reduced as soon as the main honey-flow is over and wasps begin to be plentiful. If wasps begin to get the better of any stock (which can be seen by their regular traffic at the entrance) it can usually be saved by changing its place with that of a strong stock; but inability to resist the wasps is a sure sign that the stock is not nearly strong enough to winter safely, and the extra bees it will acquire by the change of place will be too old to help it much unless it is later joined with another stock, or at least stimulated to rear some late brood. Considering their size, we must be thankful that hornets are somewhat cowardly. If they attacked as vigorously as wasps, the bees could certainly not resist them. They can catch bees on the wing, but they never seem to be plentiful enough to do any serious harm, and half the country is entirely without them.

Tits will sometimes develop a habit of tapping at the entrance in cold weather and snapping up any bees that come to investigate. It is not very common, but can, I believe, become quite serious if enough birds know the trick. It is probably best, if you can, to shoot the tit that

makes this brilliant discovery, before he educates the others.

Badgers can break into a weak or rotten hive or overturn a skep, but I have never heard of one getting into a sound modern hive. Seeing what they can do to a poultry-house, I am surprised they do not do more damage, but I have never suffered from them or from woodpeckers, which are such a nuisance in some districts that the hand-holds on the hive walls have to be protected from them.

Smaller nuisances are the wax moths and the bee louse. The bee louse appears to be a very large parasite, living on the thorax of the bee. There may be more than one on a bee, and as many as half a dozen on the queen. If it were a true louse, sucking the blood of its host, it would be a serious menace, since in size it compares with the bee as a lobster does with a human being. But apparently it merely uses its position on the bee's back to filch food from around the bee's mouth. Even so, it must be a bit of an encumbrance. Half a dozen lobsters on a man's back (even without claws) would definitely reduce his enthusiasm. Its larva makes little tunnels in the cappings of honeycomb. There seem to be some seasons when it is plentiful and others when it is scarce, and there is nothing that the beekeeper can do about it which would not be more harmful to the bees than the louse itself is.

The wax moths (large and small) are very destructive of any combs which are not actually occupied by bees during the warmer months. Their larvae will eat plain wax (even foundation which has not been drawn out) with relish, but they prefer to vary their diet with old pupa cases and pollen, and if they are given the choice they will eat an old comb before they eat a new one. The larvae of the smaller moth will often manage to live in the brood-nest of a colony, although the bees will throw them out if they catch them. They show a quite remarkable

turn of speed in moving from one place of safety to another. Their favourite trick is to tunnel immediately under the cappings of sealed brood, often exposing the heads of the pupae, and sometimes damaging them. They retire to pupate inside a very tough cocoon in a saw-cut in one of the top bars, under the quilt, or in any crevice where the bees cannot reach them. Some strains of bee are better at hunting them out than others. The best treatment for this is to reduce the number of places where the moth larvae can hide or pupate. Saw-cuts made in the top bar of the frame for fixing the foundation should never come through to the top, and quilts should be of heavy material which lies flat on the frame-tops. Undoubtedly this is a point where the crown-board has a great advantage over the quilt unless the frames are free from sagging and the quilt is made of canvas.

If a hive is left empty in summer, its combs, especially if they contain pollen or dead brood, may be reduced in two or three weeks to a complete shambles by the larvae of the larger wax-moth, and any combs stored indoors need protection in the summer and autumn. Moth balls may help to keep the moth away, but the simplest thing to do is to keep your combs in stacks of supers, securing the top of the stack and any doubtful joints with paper. But in most seasons super frames which have never been used for breeding are not likely to be seriously attacked during the short period when the weather is warm and they are not on the hives.

Chapter XII

MORE MANIPULATIONS

UNITING STOCKS

In fair weather, during the honey season, two stocks of bees can nearly always be made into one by simply putting them together in the same hive. If both sets of flying-bees are wanted in the union, the two hives must be close together at the time, or one of them must come from a distance. All equalization, in which a bit of one stock is given to another, is uniting in a small way, and the same conditions rule. But when the bees are always repelling robbers, as sometimes in the spring and always in August and September, they are suspicious of strangers, and if two stocks are put together without precautions they may fight most bitterly until one has the upper hand. By this time there may be but few bees of either stock left alive.

Direct uniting can be done safely only when honey is available and most of the flying-bees are out of the hive. Do not believe the story that when two lots of bees are put together the better queen always survives, but be sure to kill the worse one. If you want to mix up the frames which contain brood, it is best to wait for a couple of days after the stocks are united, otherwise the queen you wish to keep may get put against the stranger bees and damaged or destroyed. The two stocks may be put side by side in a single brood-chamber, or one above the other in two separate chambers.

Indirect uniting requires some means of delaying the actual mixture of the two lots, although they are in the same hive. This can be done by putting a gauze screen between the two hive-bodies and then removing it two days later. Remove it very gently either towards evening

or when bad weather keeps the bees quietly clustered. More simply, use a double sheet of newspaper and make a few small nail-holes in it so that the bees are encouraged to tear it to pieces. Although by this method the two stocks may unite themselves in only a few hours, it is almost always quite successful. It is the disturbance of the manipulation which makes the bees so suspicious; as soon as they have settled down again they no longer look for trouble.

When you want to unite two small stocks in one hive-body you can use newspaper in the same way, folding it and fitting it down to the floor, but you can dispense with it if you are prepared to do the job towards sunset, when the bees have already clustered. The stock which has to be moved should be disturbed as little as possible; it should be carried two or three frames at a time and kept at one end of the hive, separated by one or two empty frames from the other stock. A quilt should be used to prevent any quick mixing of the stocks above the frames.

The later in the season it is and the worse the weather, the easier it is to join two stocks without any serious loss of flying-bees. In September it is hardly necessary to move the stocks gradually together or to provide for the flying-bees which go back to the old stand.

INTRODUCING QUEENS

There are three ways of introducing a new queen to a queenless stock: Direct Introduction, Introduction by Nucleus, Introduction by Cage.

When a stock is queenless it will not immediately accept a new fertile queen; they know her as a stranger, and ball her, and even if they relent later on, she is not likely to survive. Unless the new queen can be introduced almost immediately after the removal of the old one, the bees become aware that they are queenless; the colony mind gets

set along the queenless track, and it is all the harder to switch it back to the realization that there is a fertile queen in the hive. The longer they have been queenless the harder it is to get them to accept a queen, and in the honeyless period (cool spring weather, August and September) it is in every way harder, because at those times many of the older bees are at home most of the time, and their suspicion of strangers is greater. Most queenless stocks will accept a virgin queen, especially if she is freshly emerged, but they will not have her in preference to a useless queen they already have. In a stock which has been long without a fertile queen they will cling faithfully to a wingless virgin, a virgin too old to mate, or even a laying worker. You see, they have no sense.

Direct Introduction, like direct uniting, depends upon putting a new queen in place of the old one, using favourable conditions of weather and season, and only as much delay as is necessary to avoid the suspicion which results from a disturbance of the stock. Various methods have been tried by which the old queen is removed in the afternoon and the new queen run into the hive after dark. These have apparently been successful in some people's hands, but they are a very long way from being reliable, and I certainly would not recommend them unless you want to experiment first with some worthless queens. They seem to me to deny the first principle that the actual introduction should be carried out when most of the old bees are out of the way. But some of the new methods of semi-direct introduction are, I believe, very successful. These methods use a cage, but not in quite the same way as it is usually used. In Manley's new introducing cage, for example, the first stage of introduction is carried out in half an hour or so. The old queen is removed, and the new one is immediately imprisoned in a cage, which is pushed into the face of one of the

brood-combs. In a very short time the bees eat away a bit of candy on the side of the cage, and this exposes a slot of excluder zinc, which allows them to get to the queen, but does not allow her to get out. A few hours later again they eat out a larger hole blocked with candy, which allows the queen to escape.

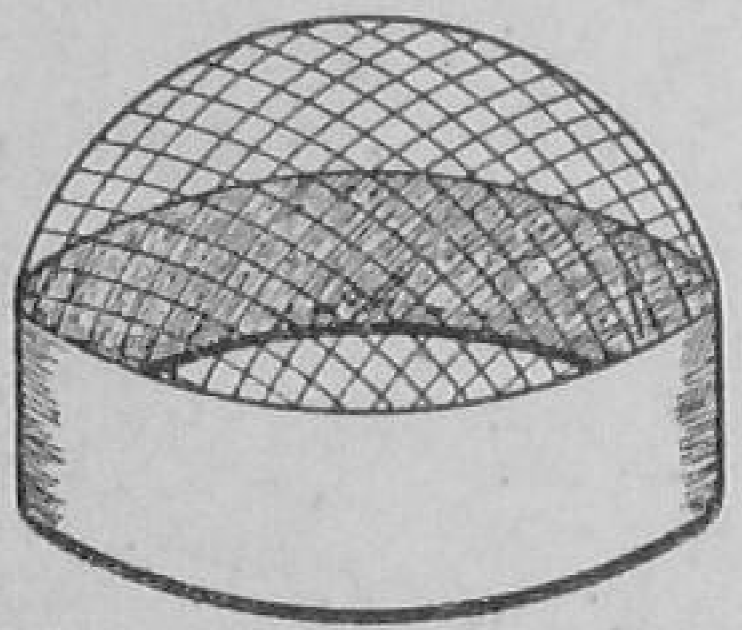
I have little experience of these methods myself, because the system I use does not call for them. It is clear, though, that some sort of automatic introduction, which requires no second visit, is a vital need to the larger beekeeper who has out-apiaries to look after.

Introduction by Nucleus is simply the uniting of a smaller queen-right colony with a larger colony which has just been made queenless. No cage is required, and a second visit is not only unnecessary; it is undesirable. Sometimes, when the colony to be re-queened has not a full-sized brood-nest, you may wish to add the small colony to the large without taking anything from the large one. In that case remove enough frames (without brood) from the brood-chamber of the large stock to allow for the three or four frames of the nucleus, take out the queen, and put the complete nucleus at one side of the brood-chamber, preferably the side which was least occupied by the large stock. If the nucleus is at all weak, try to arrange to leave a broodless frame between the two brood-nests. Some provision must be made for the flying-bees of the nucleus to join another nucleus or to help start a new one.

If you wish to maintain the nucleus take brood-frames from the large stock (with more or less brood, according to the strength required in the nucleus) and give them to the nucleus in place of the frames transferred. The queen, too, can be given to the nucleus in place of its own, either to keep it going until another cell is available or to be used for breeding.

Introduction by Cage is still, perhaps, the commonest method. Apart from the quick automatic cages used in semi-direct introduction, there are a number of slow automatic cages and others which have to be opened by the beekeeper. The idea behind all these is not so much to fool the bees into thinking that the new queen is their old one, as to hold the new queen in contact with them until she loses the characteristics of a stranger, the strange odour or whatever it may be, and is accepted.

Queen bees which are sent by post travel in a cage which is intended also for introduction. When the wrappings are removed from the gauze face of the cage and a



13. *Pipe-cover queen cage.*

bit of card from the tunnel is plugged with candy, it becomes a slow automatic cage. But as an introducing cage it has two disadvantages. It is too big to be put between the combs in the middle of the nest, among the young bees who are most likely to accept a stranger, and when it is put on top of the frames, the queen and her attendants are exposed to the colony through only a narrow strip of gauze. Her presence is not forced upon the bees' attention, and they may disregard a neighbour whom they do not want to know. If you use this cage it is safest to make the introduction slowly. Keep the card over the candy for at least twenty-four hours, so that it will be two or three days before the queen is released.

A much better type is the old 'pipe-cover' cage or its

equivalent, which can be made in a minute or two by folding a bit of perforated zinc. The queen and one or two workers are inside this when it is pushed into the face of one of the brood-combs somewhere where she is allowed both a little food and some empty cells. She is in the brood-nest, and she often starts to lay, which helps to get her accepted. Two days later, during the busy part of the day, the beekeeper gently opens the hive and removes the cage, watching for a minute or two to see if any bee attacks the queen. If so, he cages her for another day.

Introducing to a stock which has been long queenless is no fun. Sometimes the bees will accept a virgin, sometimes a cell. Sometimes they are only prepared to rear a queen from brood given to them. If a laying worker has just begun to lay they will often accept nothing at all, and you cannot find the laying worker to kill her. In any case, there may be more than one. Later on, when they find the laying worker's brood unsatisfactory, they will start queen-cells with her eggs, and they may at this time accept a given cell. But before the stock can get a new queen and rear brood it will be practically extinct, and it is usually best to deal with these cases by some form of uniting. If that is not possible, exchange the few frames which hold the laying worker's brood (and all the bees on them) for brood-frames from another stock. You will probably need to bring some nurse-bees with the brood-frames. The chances are that this will get the laying worker destroyed in the queen-right stock, and you will be able to re-queen the other by any normal method a day later.

ROBBING

If you expose a saucer of sugar syrup on a warm day in June, it is quite likely that not a single bee will pay any attention to it. If you do the same towards the end of July, when the honey-flow is failing, a few bees will soon

be making regular trips, carrying the syrup home, but it may be some hours or even days before the saucer is empty. But in August or in April it will be dense with bees a few minutes after it is first discovered, and some time after the syrup has gone there will still be a mass of bees three or four deep searching the site of their short-lived happiness like dipsomaniacs sucking empty bottles. Any drop of honey spilt or any frame exposed during manipulation attracts bees quickly during the dangerous periods, and warns the beekeeper that he may be helping to establish robbing habits. For robbing, like legitimate honey-getting, is a habit which grows.

Suppose that during July a few bees find some spilt honey and take it home on a day when there is no honey-flow. The field-bees of the stock will be excited by the income, but very few of them will stop to watch the dances of the bees that found the honey, and so learn where it came from. The great majority will fly to the bit of ground where they were getting honey yesterday. Finding that their usual flowers are not yielding, they will come home and settle down again. For it seems that bees work a little bit of ground – it may be only a few square yards – until it is exhausted. (This explains, by the way, why you will find bees from a single hive all over a large field of clover, although the bit nearest the hive may be capable of yielding far more than that stock can carry.) But if the bees have not been getting any honey for several days they will quickly follow up the new source, and if a number of them get a sip of honey there they will fix it as their stamping-ground, so that every bit of income which comes into the hive from any source will bring them back to that spot in thousands. If that spot contains a stock which is not very strong in field-bees it will be overwhelmed and stripped in a few hours. Even a weak stock will fight off the occasional robber who is just scouting,

and prevent it getting that one sip of honey which brings other bees from the robber's stock, but against a strong attack of bees that *know* there is honey to be had there it is helpless.

Syrup-feeding, especially of the stronger stocks, greatly provokes robbing, for it sends many of the bees frantically searching for the source of the big income which has suddenly started to come into the hive. If there is any weak stock from which they have managed during the last few days to get even a drop or two of honey before being driven off they will attack it strongly. Meanwhile the weak stock, if it is also being fed, will be less able to resist because most of its field-bees will be busy taking syrup from the feeder. In any case both feeding and manipulation lead to more and more bees learning to fix themselves on some moving object or some smell which can be counted on to pay them an occasional dividend. Just as, when bees have successfully broken into a newly creosoted hive (page 90), they attempt all others which have the slightest smell of creosote about them and crawl hopefully about on empty hives and fences, so they come to associate easy gains with the sight of the syrup tin, a hive with its roof off, and even the beekeeper himself, and even more with the smell of the smoker or the beekeeper's Brilliantine, if he is unwise enough to use it. Nearly always, when you have been manipulating in August and you stop because robbers are becoming a nuisance, you will find bees investigating your smoker when you put it down. Better your smoker than your head, but when things have reached this stage it means that a crowd of bees is following you, ready to pounce the moment you open another hive.

It is, perhaps, worth making a distinction between *fast* robbing and *slow* robbing. I call it fast robbing when all resistance is overcome and the stock is stripped of honey,

and slow robbing when most robbers are resisted but some are tolerated as though they were members of the stock, and gradually remove the honey, even over a period of weeks. Slow robbing seems to get started in two ways. Either there is some affinity between two stocks and they share the same colony odour (they may be divisions of one stock or separate stocks which have been treated with the same preservative or medicine), or one stock may have started to rob another and then been checked either by a change in the weather or by greater resistance, but not before a proportion of the robbers have become accepted as members by the robbed colony. For it seems that robbers, when they have been successful often enough, get something of the smell of the robbed colony and are not challenged at the entrance.

Checking slow robbing is quite easy so long as it is discovered in time. If there is a certain amount of honey in the fields it may be enough to exchange the places of the two hives. The robbers may then go to work legitimately. But they are still acceptable in both hives, and if you are unlucky they will simply reverse the process and begin to carry back again what they have recently stolen. It is usually better to exchange the robbed hive for another with no affinity. The limited number of robbers then meet strong resistance and give it up.

When stocks have their stands exchanged in this way the bees which come home to a strange hive unsuspecting are accepted at once. There must be something in the demeanour of the robber which is even more important than its strange smell in bringing the entrance guards to attack. You will often see the guards challenge a bee and let it pass, but you will also see guards take wing to grapple with an obvious robber in the air.

Avoiding the start of robbing is a matter of common sense and experience. Don't manipulate during fine warm

weather, when there is no honey in the fields. Choose the evening or a cloudy day or even a light drizzle. When there is honey in the fields, as in late April and May, but the weather is likely to be too cold for nectar secretion, choose the warm days and avoid northerly weather. If you must manipulate when trouble-hunters are about, stop before they become a serious menace either to the opened stock or you, for they sting most freely when bent on robbery. Try to do all your feeding in the evening, and don't feed weak colonies at the same time as the strong ones are being fed or excited in any other way. Keep the entrances small in spring and autumn so that the guards have less to protect. Avoid small holes which may allow robbers to get at the unoccupied part of the hive – through the roof, for instance. These holes, if they are far from the brood-nest, may not be defended until it is too late. Don't put a colony into a hive which has been painted or treated with preservative at any time when there is a threat of robbing, and never put a weak colony into such a hive unless there is plenty of nectar in the fields. Leave reconditioned hives out of doors for some time before using them. Don't judge the strength of a colony for this purpose by the number of bees. It is the field-bees which count; a colony made up of young bees is easy meat for robbers. And, above all, do what you can to avoid ever having those very weak stocks which are almost certain to become the victims of robbers. Worst of all is a very weak stock with many frames of honey to defend. Such a stock is unlikely to be able to catch a robber once it has got past the guards. Where several stocks are kept there is often one of this sort in the early spring, a queen-less stock, perhaps, which has nearly died out. When robbers have cleaned it out in the first warm weather in March they will look for another victim and attack some stock which has not joined in the robbery, and so, being

unexcited, is still in its winter condition, without entrance guards. For the guards are there only when they are called for. You will not see them in winter or high summer.

Checking fast robbing is not easy unless you are prepared to move the victim a mile or two away. If you do this, any robbers that are caught will be bound to join their victims and help to make good the flying-bees which were lost before the stock was overpowered. Short of this drastic and almost certain treatment there are one or two things which may be worth trying, though they are likely to be more trouble in the end than moving the stock. Unless the bees are near the house, so that the robbery is given away by the pandemonium, it is likely to be finished before it is discovered. Even when the excitement is noticed it is often mistaken for a honey-flow. If the robbery is discovered before it is fully under way, and the victim is a fairly strong stock, there may be some hope in making the entrance very small and disguising it. Turn the hive a little aside, or put a sheet of glass in front of the entrance so that the bees have to walk round it. This will prevent the robbers pitching straight on to the entrance, and give the guards a breathing space. But you must then watch to see that the guards have got the better of the situation. The robbers can often be distinguished by their being a slightly different colour from the victims; sometimes, when there has already been some robbery, a proportion have a highly polished look; but these are only the old lags whose fur has been rubbed off in the rough-and-tumble of a pirate's life. The bulk of them look quite normal, but they have a rather stealthy and evasive approach which helps to distinguish them. If the robbers are beaten off they will probably go home in about an hour's time, but that stock will remain liable to a new attack for some time unless nectar becomes available in the fields.

When a stock is overwhelmed, the queen is not usually killed. More or less of the flying-bees are lost, and the stock is left to starve. Some of the brood is inevitably lost, and all of it will probably die unless the beekeeper discovers the robbery the same day. If the stock can be moved it should be given food and moved at once. If not, it is no good giving it food and leaving it where it is. It should be united with another stock, but the united stocks should not, of course, be put on the stand which the robbers know. If this is not convenient, give it one or two combs with food in them and gently change its place with that of a strong stock in the evening. Don't bump the strong stock, or the bees may mark their new position when they go out in the morning, and get this stock from as far away as possible – twenty yards or more if you can. Its bees will not be too ready to settle down on the barren combs of the robbed-out hive, and if they can find their original stock again they will. If they do, they will take with them the food you have given to the robbed stock, and you will be back where you started. If you are lucky, the strong stock will send all robbers about their business in the morning, before it loses many of its flying-bees to the robbed stock. If you are unlucky, this strong stock may itself later become a victim, though most likely it will only be robbed slowly by its own bees from the other stock.

Chapter XIII

HONEY AND WAX

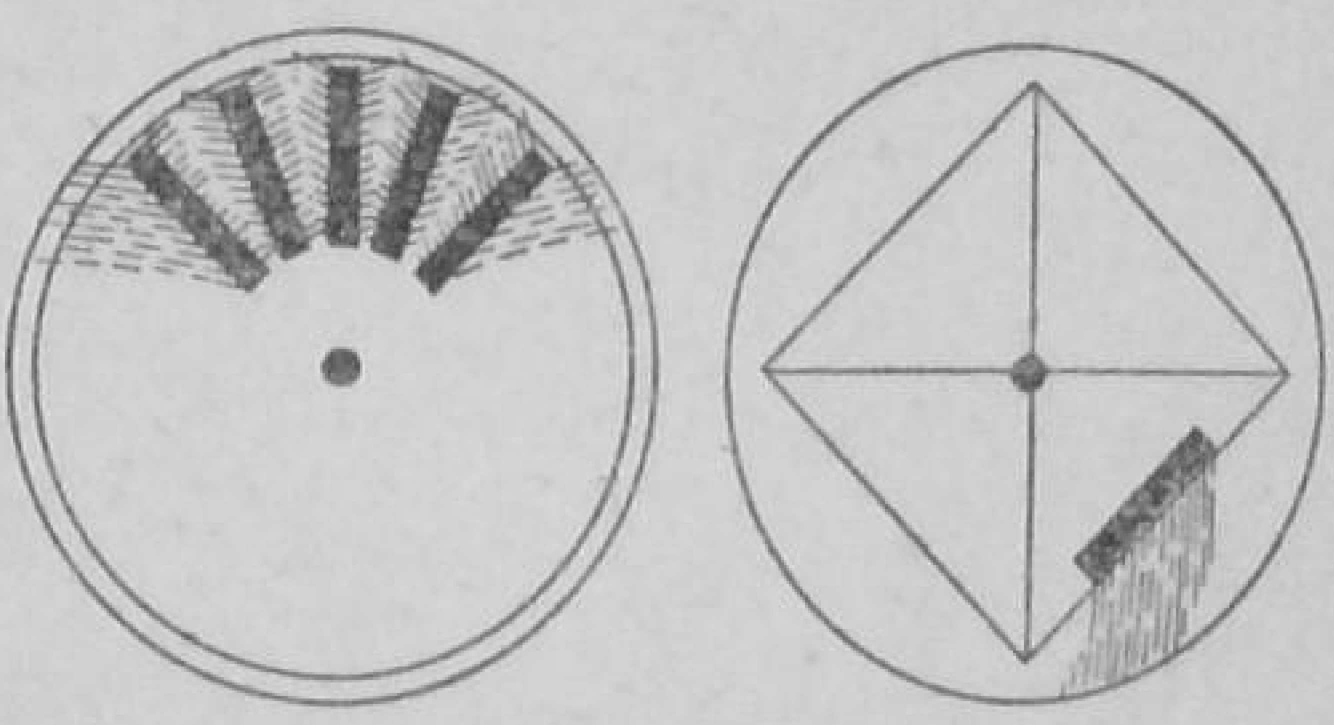
Because unsealed honey attracts water to itself from the air, and sealed honey is far stiffer and stickier at a temperature of 60 degrees than it is at 70 degrees, it is well to extract it at once when it has been taken off the hive. If that is not possible and the weather is cool, it may pay to stand it in a warm room for twelve hours before extracting. But somehow, although it may be brought back to the same temperature as when it was first brought in, it never again runs quite so freely. If it has to be kept for a week or more it needs dry storage.

If the crop is all taken at one time, it is best to wait until about a week after the flow has ceased, so as to allow time for the evaporation of the unsealed honey. Unless a second flowering of Red Clover or some other plant makes a real flow in August, there is no need to wait for the odd dribs and drabs of honey which come in after the main season is over. These may just as well go into the brood-chamber. But if there is more than one super on the hive and some of the honey is taken off earlier in the season, it should be almost entirely sealed, especially if a flow is actually going on when the honey is taken. If your impatience is great, it is best to take all the sealed frames from two or more supers and put back all the unfinished frames. Unless it is a very good season and the frames are needed for refilling, this is merely extra labour for the enthusiast.

EXTRACTOR

The only type of extractor which is commonly used by small producers is the *tangential*. The combs are whirled round with the comb-face facing outward towards the

drum, and one side is extracted at a time. There are other kinds in which both sides of the comb are extracted at once, either by sending the frames head over heels, or by arranging them like the spokes of a wheel with their top bars outward. But these *radial* and other non-reversing extractors (which incidentally are the oldest and not the newest type, though they were forgotten for many years) have to be large to be efficient. They are much slower than the tangential extractors, and save effort only by extracting a large number of combs at once. The amount of



14. *Types of extractor, seen from above. (Right) Tangential and (Left) Radial.*

turning they need is beyond the endurance of most people, so unless they are power-driven the job is not likely to be cleanly finished.

Since it is centrifugal force which throws out the honey, efficient work depends on three things: the viscosity of the honey, the distance of the comb from the centre spindle, and the speed at which it revolves. All small extractors need the honey to be in perfect condition for extracting, because the comb is inevitably rather close to the spindle: many of them make matters worse by having too low a gearing. For purposes of comparison, my own tangential extractor, which is very old and very efficient, has a minimum distance from spindle to comb face of 7 inches and a gearing of 1 to 5, which gives it a speed (on hand power) of about 600 revolutions a minute, that is five

times faster than your hand can turn the handle. At a temperature of 70 degrees it cleans out one side of the comb in about two minutes. Even with patience it is probably difficult to make a clean job if your extractor gives less than half this speed and has less than half this distance from spindle to comb.

The bigger and more expensive tangential extractors contain a device for quick reversing of the frame, so that it does not have to be taken from the machine to turn it round. This is a great boon to the man who has thousands of frames to extract, but only saves a few minutes for the man with four or five stocks. But if there is no reversing device, there is always a danger of breaking combs through not reversing enough, for a frame must never be revolved at anything more than a very slow speed unless most of the weight has been removed from the other side. This means two reversings for each frame. First extract 90 per cent of the honey from one side at about a quarter speed; reverse and go up to full speed to clean out the other side; then back again to finish the first side. This is specially important if the combs are new, because they are more brittle then, or if they are self-spacing frames (either close ended super frames or hoffman frames), because in these the comb does not touch the gauze of the extractor reel which would otherwise support it.

However careful you are, extracting will find out any bad work in the wiring of the frames. A few cracks do not matter much, but it is distressing when lumps break out of the comb. Old tough brood-combs will stand much rougher treatment than the super frames which have no silk to strengthen them. With these the risk is rather that the wires will have rusted where they pass through the frame, and the whole comb will fall out in one piece. They can be secured again with bits of wire pushed through the comb and twisted round the sides and top.

bar, but this makes them awkward to uncap next time, and they are liable to fall out again. Stainless steel or monel metal wires, which cost hardly a farthing extra for each frame, prevent the trouble.

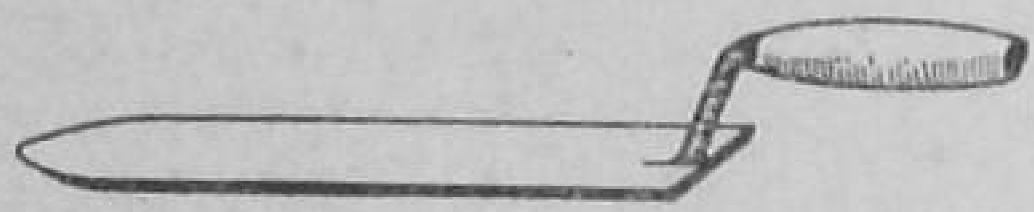
But before the frames can be extracted they must first be uncapped. From the point of view of getting the honey out of the comb it does not matter how the uncapping is done, so long as the cells are opened. We used to be advised to cut immediately under the capping, taking as little wax as possible, but this is wasteful. It wastes time, because the cappings are rarely flat, so that you have to go in and out all over the place if you want to keep just under them. If the bees start filling the cells of one comb before they start on its neighbour, they will probably build those cells out into the passage-way at the expense of the later comb. The length of the cells is not fixed, only the bee-space between the two faces of finished cappings. It also wastes wax if the cut is made above the level of the woodwork of the frame, for the projecting cells are crushed down to the level of the woodwork against the gauze of the extractor, and the bits of wax later fall off.

Brood-frames which have been part of the brood-nest early in the season, and later become storage frames while keeping their original spacing of 1·5 inches, are always awkward to uncap, and need a certain amount of digging and scratching, especially if you have actually to cut through the pupa cases. Even when brood-frames have been used only as storage frames and have been wide spaced, they are still a bit clumsy. The wood (intended for brood spacing) is usually rather narrow, so that the comb projects a long way, and the bottom bar is often narrower than the top bar, so that a clean sweep with the knife is impossible. Even some super frames are made like this. Patches of stored pollen can also hinder the knife. I know it is always with a sense of relief that I finish my

small batch of these and turn to the proper super frames which have woodwork 1·25 inches wide all round them and are spaced at 1·8 inches. These rarely have any of the cappings below the level of the wood, except the first time they are used, when a frame containing foundation is put beside one which is already built out.

In whole sheets or in little pieces the cappings must come off. The best knife is sharp, hot, wet, and heavy – heavy so that it will hold the heat long enough. A thin knife loses its heat to the honey almost at once, but some thin serrated knives make a fairly good job when cold.

There are, of course, more complicated devices for doing the same thing – steam or electrically heated knives and planes, even uncapping machines. These are un-



15. *Uncapping knife.*

doubtedly superior to a good uncapping knife, but not as much superior as a good knife is to a bread-knife. The crooked handle and the thick blade make all the difference in comfort and speed. It conveniently stands in a tall tin of water, which is kept simmering. If the top of the comb is kept tilted a little over the blade, the cappings will fall clear, and not stick to the comb.

Where the crop is small it is not really worth while to have a specially made cappings melter. This is a sort of heated tray, heated just hot enough to melt the wax, but not hot enough to damage the honey if it runs off quickly. The wax and honey run off together into a pail, and the wax is taken off the top after it has cooled and set. With a little patience the whole job can be done without any special equipment if you have a large enough open vessel. A galvanized washtub will serve very well. Don't be afraid of the poisonous salt which honey is said to form

when in contact with zinc; it will not be in the tub long enough to suffer any harm.

Fix a narrow bar of wood from one handle to the other as a support for the frames when they are being uncapped, and carry on until you have finished the extracting or the tub is as heavy as you want to lift. Then fit it with some rough kind of lid, which can be of gauze or wood or metal. The lid can be held in place either by being fixed to the sides direct, or on the underside of the bar. The tub is then propped up on end and left for half an hour. Ninety per cent of the honey will usually run out. Then heat the tub by standing it on small supports in boiling water. If you have no large flat vessel for the water, you can use direct heat, if you are careful enough. The gas or electric heater should be kept an inch or two away from the tub, and a heat spreader such as a flat piece of iron should be between them. A piece of iron as large as the bottom of the tub is as good as a water-jacket, and certainly saves time.

The point of this is to avoid getting a small hot spot inside the tub, since the heat cannot travel fast through the paste of honey and wax. The aim is to get the whole mass up to the temperature of a hot bath, but if the heat is not spread the wax will melt, and the honey may even boil immediately above the heater, while the rest is not warmed at all. Honey so heated will be very much darkened, and will lose all its finer flavours. All heat damages honey in some degree, but the lower the temperature the slower the honey is to show signs of damage. Neither half a minute on a cappings melter at 140 degrees nor half an hour in a tub at 120 degrees leave any noticeable trace, but it has been shown that even at 90 degrees honey becomes dark and tasteless in a year or two. Since in the tub only one-tenth of the cappings honey (say one-fortieth or fiftieth of the whole crop) gets heated at all, the slight

damage this suffers is not of any importance. But if you value a fine, even granulation of the honey in the autumn, it is important to mix the heated honey with the bulk, because even 120 degrees may break up the small invisible granules which are already in the honey, and this mildly heated honey may granulate slowly and coarsely if it is kept separate.

When your tub has reached an even 120 degrees it should be tipped on end again and left as long as possible. After this there should not be more than about 2 per cent of the cappings honey left in the tub. If you make mead you can get even this undamaged. Add a suitable amount of water. If you weigh the water, you will be able to find out later how much honey has dissolved in it, so that you can get your mixture right. (It is usually 3 lb. of honey in a gallon of the mixture.) Warm again, and stir the whole lot together to wash the honey off the wax. Then pour it off, add more water, and heat until all the wax melts. Set aside and remove the cake of wax when it is cold. Wax is slow to heat and slow to cool: a large cake may take twelve hours before it is really solid in the middle.

But if you do not make mead you will have to overheat this last 2 per cent of the cappings honey. Slowly heat the tub until all the wax melts, but be careful to take it off at once as soon as the last bits are melting. So long as the heating is slow, the melting wax will take up all the heat as soon as the temperature has reached about 150 degrees, and the temperature will not rise much until all the wax has melted. When the wax has set and shrunk from the sides, the honey can be run from under it. The darkened honey is not unpleasant, but a bit like toffee. It will not granulate. If you do not want it for cooking or making home-made cough cures it can be made quite good for the table by stirring into it when it is warm (but not hot) a little of last year's granulated honey – say 1 lb. in ten. It

will then granulate properly. Any honey which does not granulate well naturally can be treated in this way, but for a fine granulation it must be seeded with fine granules. If no fine granules are available they can sometimes be made by crushing coarser ones.

It seems that the fineness or coarseness of the granulation mainly depends on how quickly it starts. Some plants, notably Charlock and all the Mustard and Cabbage families, produce a honey which very quickly begins to granulate: in fact pure Charlock honey is often found granulated in the comb in September – a nuisance to be avoided at all costs. The quicker the granulation the finer the granules. Some other honeys, such as Holly, are very slow starters, and six months after extracting may be found with just a few coarse crystals at the bottom of the jar. Pure Ling Heather honey is also very slow or does not granulate at all. Any honey which has its granulation entirely broken up by heat tends to behave like the Holly honey. But the granulation is very much in the beekeeper's control if he judiciously mixes his honeys and seeds slow granulating and liquified honeys with fine granulated honey. Fortunately our mainstay, the White Clover, granulates fairly fine on most soils, but its texture (and many think its flavour) is improved by a little honey of the Charlock type. It is this mixture which makes the prize honey of the chalk districts; light amber-coloured when it is liquid; almost white when it is set, and so fine that you can hardly see the granules.

Honey is awkward stuff to strain without heating it a little. But heating does it no good, and may upset the granulation, and for ordinary purposes it is certainly not necessary to strain the bulk of the honey. If it is stood for several days in a warm place, all wax, froth, and so on will go to the top and the very few bits of heavy rubbish will go to the bottom. A tap near the bottom will then

withdraw nearly all the honey in a clean condition, and only the few pounds that are left when the scum has nearly reached the level of the tap have to be warmed and poured through a double thickness of butter muslin. If you do not wish to have a special vessel for this job the drum of the extractor with the reel removed will serve.

The wax has to be reasonably clean before it will be accepted by the factory. When the combs which have been extracted were free of pupa cases the cleaning of the wax is a simple matter. If it has been thoroughly melted, all the dirt will be at the bottom, and it may be possible to chisel it off (with a little of the wax) without more ado. If some of the dirt is mixed with the wax higher up, it will have to be melted again, and the process repeated. But if brood-combs have been extracted and there is a good deal of 'slumgum', heat the whole lot a good deal above the melting point of wax and pour it, water and all, through butter muslin. Some of the finer dirt will still be under the wax, but it can be scraped off.

HEATHER HONEY

The honeys of the Heaths, Bell Heather, and Cross-leaved Heath, can usually be extracted, but the honey of the Ling, true Heather honey, is a jelly, with the curious property that it becomes liquid for a few minutes after it has been stirred. There is a tool, the Loosener, which allows you to stir each individual cell, and so extract it. It is a sort of hairbrush with nails for bristles and a spring behind the nails which you have to dab all over the comb while it lies on a flat board. If all the honey in the comb is not Ling Heather it pays to extract it first, so that you do not have so much work. The whole business is tedious and messy, but it does preserve the comb without any serious damage. The ordinary commercial method is to drive the honey out under great pressure in a Heather Honey Press,

destroying the comb. An intermediate method is to scrape off cells and honey down to the midrib, so that the comb is in effect reduced to a sheet of foundation. The resulting mixture of wax and honey can be cleanly separated only by pressing; a partial job can be done with heat, but Heather honey does not let go of the wax as ordinary honey does.

FERMENTATION

Fermentation is a kind of decay of honey in which it becomes bitter and unpleasant; in bad cases it swells and bubbles. Probably the seeds of the ferment are in all honey, and it depends on circumstances whether they are able to grow or not. Fermentation usually starts in the summer following the bottling of the honey, and almost invariably it starts where the water content of the honey is higher than it ought to be, either because it was extracted before it was ripe, or because it was left about in a damp atmosphere so that it could absorb moisture from the air. In a cool, damp season the whole crop may be wetter than it is in a dry season. Heather honey, strangely enough, contains more water than other honeys, and is almost certain to ferment unless vigorous steps are taken to prevent it. Very few people have accurate means of measuring the water content of honey, but a fairly safe test can be made in cool weather in autumn. Sound honey at this time should be very reluctant to move if the jar is tipped, and it should be like this right up to the top. Any honey which slops easily or has a liquid film on the top is suspect. A thin film on the top means that the honey was not left standing long enough after extracting to allow the unripe honey to come to the top. A good deal of water can be taken from honey by allowing it to stand for several days at a temperature of 90 degrees to 100 degrees, beside the kitchen stove, for instance, or on the

hot water-tank. But it is best to pasteurize any that is in the least suspect, and especially any that has been lying around for any length of time in a thin condition. Heather honey should be treated at once. It may even ferment in the comb before you get it out. The honey will suffer far less if it is heated to 140 degrees for only a minute or so. The simplest way I know of doing this is to heat it all together to about 120 degrees and then let it run slowly through a tap into a pipe which is right on top of a heater. Adjust the tap until the honey runs out at 140 degrees. If it is to be mixed with granulated honey, do this as soon as it is cool enough not to melt the granules and seal it up while it is still warm.

BOTTLING GRANULATED HONEY

There are many good reasons for not bottling all the crop as soon as it is extracted. Commercial producers are too busy at this time of year, but many of them would not do it if they could. Honey bottled in August is usually at its best in November and December. After that it tends to get too hard, especially if the season was dry; it will not spread, and it bends any spoon which is not made of steel, and it stays like this until May. It loses some of its good looks, too, by shrinking away from the glass and leaving frosty-looking patches. But if it is allowed to granulate in honey tins or some other airtight containers and then put into its jars in the middle of the winter, it will not get too hard until a year later.

To get it out of the tins you must stand them in very hot water until the outside half-inch of the honey has liquefied. Before putting the tins in the water it is wise to scrape off the bit of froth which is on the surface, because the seeds of fermentation are likely to be concentrated there. Any tins with thin liquid honey on the top should be used before summer or pasteurized. Tip the lumps of honey

into an open vessel and heat slowly, cutting up the honey and stirring it so as to get all of it warm. It becomes a fluid paste, about half-way in colour between liquid and granulated honey, and it can then be bottled through a honey gate, which your extractor provides for you. Within a few days it will be fully granulated again, but it will be soft.

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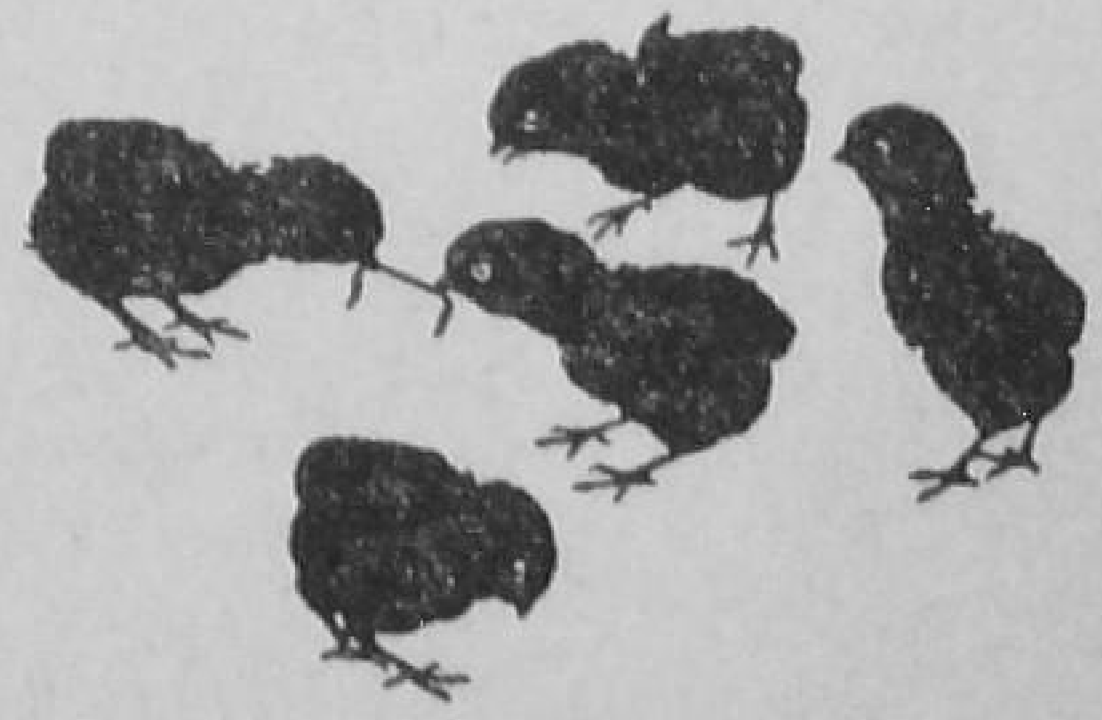

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